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16 July 1984

# China Report

ECONOMIC AFFAIRS

ENERGY: STATUS AND DEVELOPMENT -- XXIX



FOREIGN BROADCAST INFORMATION SERVICE

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## NATIONAL POLICY

### SOLUTIONS SOUGHT FOR NORTHEAST'S PROJECTED POWER DEMAND

Beijing LIAONING RIBAO in Chinese 16 Feb 82 p 3

[Article by Zhang Wei [1728 9570], chief of the Planning Office of the Northeast Electric Power Industry Management Bureau: "Resolving Energy Demands of Electric Power Industry"]

[Text] The 12th CPC Congress has put forward the goal of striving to quadruple the gross value of industrial and agricultural output by the end of this century. The energy and communications industries are the strategic key points in achieving this magnificent goal, and the electric power industry is the key point of the two and must be developed faster than before.

The task of the electric power industry is to turn a large amount of energy resources (like coal, hydropower, and nuclear energy) into electric energy. For the electric power industry to be able to quadruple its output, the problem of energy supply must first be solved. Once, some people pessimistically thought that the Northeast was an area lacking in energy resources and did not advocate that additional investment be made there in energy resources and (including electric power) in communications. They suggested that some big energy consumers be moved to areas in the North, Northwest, and Southwest, where there are abundant energy resources, and that in the future the Northeast maintain its electricity supply by saving energy. Other people thought that the Northeast's industrial potential should be tapped and its problem of electricity shortage solved, and that there was no alternative for the localities in which there was an energy shortage and in which transportation was restricted so that a large amount of coal could not be shipped in, but to build a number of large electric power plants in the Shanxi-Jungar zone to send electricity to the Northeast, and so forth. How are the energy resources in the Northeast to be evaluated? Where is the solution for the energy problem of the Northeast? Is it to be based on the Northeast's own energy resources and to transfer from inside Shanhaiguan some coal to the Northeast as a supplement, or to concentrate attention and pin hopes on the coal-rich North China area? These questions must be probed and clarified, precisely because hesitation on this problem of a strategic nature will lead to long-term insufficient investment in the Northeast's energy resources and communications, more and more "bills due" will pile up, and the serious

problem of electricity shortage will gradually become unsolvable. Only 17 years remain until the end of this century, and if a strategic decision is not resolutely made, the opportunity will have been bungled and losses difficult to estimate will be caused to the development of the entire national economy.

We think that the hope of solving the Northeast's electric power problem lies in the coal resources of the Northeast itself. Viewing the present situation we see that petroleum could immediately account for a smaller proportion of the fuels. As for hydropower resources, the hydroelectric power stations in the Northeast with a capacity of 10,000 kilowatts or more that can be developed only account for 12.7 million kilowatts and so they obviously cannot be the main energy resources. Only coal can be the main energy resources for the electric power industry. The state has already made it clear that the coal resources of the four eastern leagues of Nei Monggol must be given consideration in the overall planning of the Northeast's economic development. The three provinces of Liaoning, Jilin, and Heilongjiang and the four eastern leagues of Nei Monggol are regarded as one economic zone, in which proven coal reserves account for one-tenth of the total coal reserves of China, and we are making this our base point.

First of all, we should make full use of the abundant brown coal resources in the Northeast. Brown coal accounts for 89 percent of the 53.01 billion tons of motive power coal in the Northeast, and the great majority of it is distributed over the four eastern leagues of Nei Monggol. Not only are these reserves of brown coal large, but they also lie close to the surface and have a low stripping-to-ore ratio, so they are suitable for strip mining. Based on the plans of coal departments, when the construction of three large strip mines--Yiminhe, Huolinhe and Yuanbaoshan is completed, they will produce 113 million tons of brown coal per year; after deducting 20 percent of the coal for use by the mines themselves and for daily use in their areas, they can satisfy the demands for an installed generating capacity of 20 million kilowatts. Second, we must step by step raise the proportion of electrical energy in the consumption of energy resources and concentrate more coal on generating electricity. Practice has proved that making more use of electrical energy so that it replaces other energy sources is an important measure for saving energy resources. Statistical data from abroad indicate that in industrial production the use of electricity in place of mineral fuels on average saves 55 percent of the energy resources and about 80 percent of the costs; in buildings, the use of electricity for heating, as compared to the use of hot water, can save 80 percent of the energy resources. Therefore, the developed countries are constantly raising the proportion of electricity generated for energy consumption in the total consumption of energy resources; America estimates that by the end of this century its proportion will have reached 50 percent.

Our country wants to quadruple its industrial and agricultural output by the end of this century, and coal production can only be doubled. This fact determines that we must put into practice an energy policy of laying

equal stress on saving and exploitation, with saving made primary in the near future. In addition to doing good work on saving electricity throughout society, without a doubt an important way of saving energy is to enlarge the proportion of coal for generating electricity in the consumption of coal. Third, we must appropriately supplement the coal in the Northeast by shipping to it coal from within Shanhaiguan. According to calculations on the synchronous growth of the Northeast's electric power industry and the national economy, by the year 2000, 118 million tons of coal will be needed for the generation of electricity in the Northeast and there will still be a shortfall of about 30 million tons, which must be shipped into the Northeast from areas within Shanhaiguan. In its geographical position, the Northeast borders on North China, which has abundant coal reserves. With the Beijing-Qinhuangdao Electric Railway, the Datong-Qinhuangdao Railway, and Qinhuangdao Port, the Northeast possesses advantageous conditions for bringing in coal. It is intended to select two intersections along the Shen Railway and the Sha-Tong Railway for the construction of electric power plants, and to build one port electric power station each in Yingkou's Bayuquan Port and Dalian's Shangdao Port, in order to shorten the distance required for transporting coal and to ease the pressure on railway transportation. Liaoning's coastline is very long and highly advantageous for the construction of nuclear power stations, something to which we should pay close attention.

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CSO: 4013/158

## NATIONAL POLICY

### OVERVIEW OF NORTHWEST ELECTRIC POWER CONSTRUCTION

Beijing LIAOWANG [OUTLOOK] in Chinese No 8, 20 Feb84 pp 16-17

[Article by Xiao Genxing]

[Text] In drawing up its development plan recently, the Northwest Electricity Management Bureau hit upon a strategic idea: convert local coal and water resources into electricity within the region and export electricity to other parts of the nation, thereby hastening the development of the region as a base for electricity. The Northwest will thus prosper while assisting the nation as well. It also suggested the use of small networks for electricity transmission so that as early as 1986, 550 kV transmission of 2.2 billion kilowatt-hours could be delivered to ease the shortage in northern Sichuan, western Henan, and southern Shanxi.

After several decades' development, China basically has established a number of major power transmission networks. However, owing to a variety of reasons, we still think in terms of a local balance and fail to take into account the national perspective. Since the idea of a national network occurs to few people, the several key networks have become autonomous systems. Inter-network coordination is non-existent and inter-network regulation is even more difficult. While the Northwest network yields a surplus, its neighbors in Central China, North China and the Southwest suffer from a chronic shortage.

The value of the Bureau's proposals lies in their breaking free from the confines of regionalism and extending the concept of a network to the entire nation. They have done valuable exploratory work into the mechanics of bringing about a comprehensive balance among the electric network, the energy network, and the road network.

The Northwest electric power network currently has an annual surplus of 2 to 3 billion kwh, its excess generating capacity amounting to 1 million kilowatts during the wet season. The development plan envisages that with the completion of the small network in 1986, the construction of extra high-tension power lines can be speeded up so that via these aerial 'bridges' electricity could flow continuously to North China, Central China, and the Southwest, and such key economic areas as Beijing, Wuhan, and Chongqing. Our second goal is to export 3 million kilowatts by 1990. This will be followed by further goals, the ultimate objective being a generating capacity of 30 billion kilowatts by the end



of the cnetrury so that it could supply the three electricity-deficient networks with 10 million kilowatts, or 45 billion kwh. Electricity can also be transmitted through relaying: the Northwest network can send electricity to the Northeast through the North China network, and to East China through the Central China network.

At the moment, over 50 percent of the electricity shortages in the North China, Central China, and the Southwest networks occur during periods of peak demand. To impose some arbitrary limits on the consumption of electricity will adversely affect the national economy and people's living. An effective approach to this problem is to develop the abundant hydroelectric power resources in the Northwest. Hydroelectric generators may be started and stopped quickly and are safe and economical to operate. Once these resources are exploited, they can regulate the supply of electricity throughout the four networks with tremendous economic benefits. If the Northwest and North China networks are linked up, thermal generating units in North China can operate extra hours and can produce an additional 3 billion kwh a year. Owing to the regulating effects of hydroelectric power, thermal generating units in the Northwest will also become more productive, generating an extra 1.6 billion kwh each year. It is estimated that the additional power generating capacity in the two networks would mean an increase of 10 billion yuan in industrial putput. Moreover, the link-up between the Northwest and Central China networks will enable hydroelectric power stations on the Chang Jiang and Huang He river systems to benefit from regulation so that stations with excess water can come to the aid of those less well endowed. For example, after a flood season, the Liujiaxia hydroelectric power station and others can supplement the water at the Gezhouba station so that the latter can generate an additional 550,000 kilowatts.

The most vexing problem now facing netowrks in Central China, the Southwest, and other places is the fact that transportation facilities for coal are being stretched to the breaking point. The Northwest may produce a great deal of coal but getting it out is difficult. Shanxi coal alone is clogging the Longhai Highway. The suggestions by the Northwest Electricity Management Bureau clearly should prompt people to think along new lines. What cannot be sent on land should be sent by "air." The delivery of electricity is tantamount to the delivery of coal. Electric power plants now being planned for the Northwest will all be built near coal mines so that coal can be converted into electricity right where it is mined. Not only will this approach stimulate coal development in the Northwest, it will also ease the pressure on roads and networks, creating a three-dimensional transportation system. If we manage to send to Sichuan and Central China 10 billion kwh each, we would in effect be delivering 12 million tons of coal to these two coal-poor regions afflicted with the worst traffic bottlenecks. There will then be more capacity in the transportation system to meet other national economic needs. Apart from boosting the regional economy, the establishment of an electric power base in the Northwest would gradually attract energy-intensive industries, such as ironwork and metal processing, electric steel, electrolytic aluminum, and calcium carbide, to move to the Northwest from electricity-poor areas. As a result, the industrial distribution of China will become more rational.

Does the Northwest have the prerequisites to become an electric power base in a short time?

As we all know, the Northwest abounds with coal resources as well as hydro-electric resources, much of them still unexploited. Only 4 percent and 7 percent of its coal and water resources, respectively, have been developed.

There are other favorable circumstances. The water resources in the region are concentrated in the Huang He, Han He, and Bailong Jiang. The four provinces drained by the Huang He alone account for about 68 percent of the total developable water resources in the region. As one of the few places in China which are rich in water and electricity resources, the Huang He offers good natural and man-made conditions. Judged by such technical economic indicators as flood losses and investment returns, it is also an ideal location. The current plan calls for the construction of 15 cascade power stations between Longyangxia in Qinghai Province and Qingtongxia in Ningxia Province, with an installed capacity of 13 million kW. According to rough calculations, it costs about one-third less to build a power station in this section of the river than what it took to build the existing stations in the nation or what it now costs to build the 18 new stations, including Xinqanjiang, Danjiang, and Gezhouba. There are other advantages to turning this part of the Huang He into an electric power base. It will harness the river, promote soil conservation and help prevent flood and ice downstream. It will also benefit industry, agriculture, lumber and husbandry, and ensure a water supply for villages and towns in the lower reaches of the river. Construction can start shortly on hydroelectric facilities at Lijiaxia, Laxiwa and Daxia, etc.

The Northwest is also well suited to become a coal and electric base. The region produces coal of a high quality, its coal seams are thick, and the reserves are near the surface so that they can be recovered relatively easily. It takes less to mine 1 ton of coal in the Northwest than the national average. If only we modify the operating mines technologically and put into service new mines, we can produce an additional 12 million tons of coal within a short time, enough to meet the needs of 4 million kW - generating machinery. Furthermore, the mining areas are rich in ground water and surface water. A basic rail network is already in place. Environmental protection and the location of electric power plants are lesser problems in the Northwest with its vast size and sparse population. All these conditions create a favorable environment for the construction of pit-mouth power plants. After years of hard work by the electricity departments in the Northwest, construction can start soon on a number of large-scale coal-burning electric power plants, including Jingyuan and Daba.

12581

CSO: 4013/.15

PROSPECTS GOOD FOR NORTHEAST ENERGY CONSTRUCTION

Beijing LIAOWANG [OUTLOOK] in Chinese No 8, 20 Feb 84 p 18

[Interview with Shen Yue, Director of Office of Energy and Transportation Planning for the Northeast, by correspondent Gu Tiefeng: "Future Bodes Well for Northeast Energy Construction"; date and place of interview not given]

[Text] At present, an energy shortage is the main impediment to the further development of the industrial base in the Northeast. This situation has generated much discussion. We recently interviewed Comrade Shen Yue, Director of the Office of Energy and Transportation Planning for the Northeast, which is part of the State Council, and talked to him about the energy future of the region. The Northeast is China's key industrial base. It was built with the support of the nation and has in turn aided the construction of China. During an inspection tour of Liaoning in 1981, responsible cadres from the central authorities said, "The Northeast has four overwhelming advantages: abundant natural resources, considerable fixed assets, an advanced communications network, and powerful technological expertise." "The Northeast has the five bases for China's socialist construction: iron and steel, energy, machinery, lumber and food." The economic importance of the region is thus obvious. Comrade Shen Yue said, "The Northeast industrial base has an integrated internal economic system; electricity, coal, railroads, and oil all form part of a unified system or are closely co-ordinated with one another. However, owing to certain structural disharmonies, we still do not have a regional balance or region-wide planning. Energy production still lags behind the needs of national economic development. This deficiency has put a curb on further expanding the productivity of the entire nation. Now that the Party Central Committee and the State Council have made the energy problem in the Northeast an issue of national strategic importance to be dealt with through comprehensive planning, the stage is set for that region to play an even more important role.

"The key to solving the energy shortage in the Northeast lies in defining the goals, distribution and priorities of coal mine development." For the past half year, comrades from the Planning Office have been prospecting and investigating in the field. They have collected numerous facts suggesting that with its rich and varied coal resources, the Northeast is equipped to develop large-scale coal mines. In 1982, proven reserves region-wide amounted to 63.4 billion tons, and estimated reserves 91.1 billion tons. Of the former, production and construction would take up only 15.9 billion tons. Assuming an annual coal output of 300 million tons, production can continue for the next 200 years.



While coal mine construction in the Northeast requires more investment than in Shanxi, transporting coal from outside Shanhaiguan is very expensive. According to statistics for the past 25 years, altogether 178 million tons of coal were imported from outside Shanhaiguan by the Northeast at a cost of 2.5 billion yuan, enough to build a coal mine in the region with an annual production capacity of 20 million tons. Hence it is more economical to develop local coal resources. In addition to its numerous coal mines, moreover, the region has the necessary expertise and managerial base.

Comrade Shen Yue said, "To meet the more pressing short-term need, we have been concentrating on old mines for the past 10 years. Our priorities are to renovate and expand existing mine pits so that relatively rapid results and greater economic benefits may be obtained with the least investment. Regionally, there are ten mining areas with fairly good potential for increased output, such as Hegang and Shuangyashan in Heilongjiang, Shenyang and Tiefa in Liaoning, Zalainuoer in Nei Monggol, and Hunchun in Jilin, etc. We pin our hopes for solving the region's energy shortage on Nei Monggol's three major open-pit coal mines, including Yuanbaoshan and Huolinhe. At the same time, we should support local mines."

Referring to the need for integrated planning for and simultaneous development of coal, electricity, roads and harbors, Shen Yue said, "We should rely mainly on electricity generated by coal, but vigorously promote hydroelectric power and actively develop nuclear power as well. Our aim is to link up the power network of the Northeast with that of the North as soon as possible through the construction of a basic 500 kV transmission network. Power plants that burn coal should be located as close to harbors and coal mines as possible. During the Seventh Five-Year Plan period and the following 10 years, there will be a substantial increase in coal output, both local and that imported from outside Shanhaiguan, which would put further pressure on the transportation facilities. Therefore, we must speed up the modification and construction of railroads, harbors, and highways. In Shen Yue's opinion, hastening energy construction in the Northeast depends on three other things. First, we must insist that development and economizing be accorded equal importance, but make the latter our priority in the short run. Second, we must strengthen our geological prospecting work, make full use of existing prospecting contingents in the region and improve our prospecting methods. Third, we must take advantage of the strong machinery industry in the Northeast and mobilize various enterprises to launch a co-ordinated onslaught to produce large-scale electrical and mechanical facilities and mining equipment.

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CSO: 4013/115

## NATIONAL POLICY

### LOCALLY FUNDED PROJECTS TO EASE POWER SHORTAGE BY END OF 80'S

OW270847 Beijing XINHUA in English 0804 GMT 27 May 84

[Text] Beijing, 27 May (XINHUA)--The Ministry of Water Resources and Electric Power has raised more than 1.6 billion yuan from various localities for power construction projects since December 1981, according to a report in "Economic Information."

The ministry has signed power construction contracts with ten provinces from Heilongjiang in the northeast to Yunnan in the southwest and with Shanghai, Tianjin and south China's Guangxi region. The projects will be completed by the end of the 1980's and their combined annual output will reach 50 billion kWh, accounting for one-seventh of the present national total.

Large power construction projects used to be funded by the state. Since 1981, localities have been encouraged to invest in power construction projects and share the electricity produced. This is one of the major measures adopted to ease the power shortage in many places of China.

CSO: 4010/95

## POWER NETWORK

### SICHUAN STEPS UP WORK ON ELECTRIC POWER CAPITAL CONSTRUCTION

Chengdu SICHUAN RIBAO in Chinese 23 Mar 84 p 2

[Article by Zhong Shi [6988 6824]: "Sichuan Speeds Up Capital Construction in Electric Power"]

[Text] While working on current construction projects, the Sichuan Electric Power Department has also made a major effort on early phase capital construction and obtained encouraging results.

Success in early phase capital construction is a prerequisite for speeding up capital construction work. In the past, due to the interference of the "leftists," the hydropower and thermal power survey and design teams of Sichuan Province were "rusticated" and torn apart, survey and design stagnated, and early phase work on capital construction projects fell behind. Very few power plants are under construction and the rate of increase in power production is far below the growth in power consumption, the problem of energy shortage is becoming increasingly acute.

Since the Third Plenum of the 11th Party Central Committee, the Provincial Government has provided leadership and help and the various local governments and associated departments have been fully supportive. Owing to the hard work of the planning, survey, design, hydrology, and experimental workers of the electric power department, Sichuan has so far finished the planning and site selection, feasibility studies and preliminary designs for eight major hydro-power and thermal power projects with a total capacity of 11.34 million kilowatts. Among these projects, three preliminary design projects for the expansion of the Pengshui and Baozhusi hydropower stations have been completed for an installed capacity of 2.24 million kilowatts, the feasibility study report for the Ertan hydropower station has been completed for 3 million kilowatts, and the construction (expansion) of the Luohuang, Huangjuezhuang, and Jiangyou thermal power plants and the site selection for the Pubugou hydropower station have been finished for a total of 6.1 million kilowatts.

In order to finish the feasibility studies and initial designs of the selected hydropower and thermal power plants (stations), the Southwest Electric Power Management Bureau, the Chengdu Survey and Design Institute of the Ministry of

Water Conservancy and Electric Power, and the Southwest Institute of Electric Power Design recently held a meeting to arrange the survey and design schedule and to submit a feasibility study report of the Luohuang and Huangjuezhuang thermal power plants by August of this year. The feasibility study report for the Pubugou hydropower station will be finished in 1986. The initial design of the Taipingyi hydropower station will be finished this year and the initial design of the Ertan hydropower station will be done in 1985. These projects will lay the ground work for the construction of the three hydropower stations and the three thermal power plants planned for the Seventh Five-Year Plan.

9698

CSO: 4013/145

## POWER NETWORK

### USE OF MICROCOMPUTERS IN NATIONS'S ELECTRIC POWER SYSTEM REPORTED

Hangzhou ZHEJIANG RIBAO in Chinese 14 Apr 84 p 1

[Article: "Zhejiang University President Han Zhenxiang [7281 4394 4382] Leads Scientific Research Personnel in a Difficult Attack on Key Problems and Makes a New Contribution to the Use of Microcomputers in China's Electric Power System"]

[Text] Professor Han Zhenxiang, who was appointed President of Zhejiang University by the State Council not long ago, has boldly and creatively led scientific research personnel in a difficult attack on key problems in developing applied computer software for China's electric power industry. He and other comrades made the first adaptation of domestic small and microcomputers at the beginning of this year and successfully developed a large program at advanced international levels that has speeded up the pace of computer applications in our country's electric power system.

Modern electric power systems are enormous in scale and have fast-changing operational conditions. They are closely related to development of the national economy and to living standards. Han Zhenxiang decided to make advances in China's own applied software. With assistance from the Ministry of Water Resources and Electric Power, he organized forces in July of last year and began to adapt and develop large microcomputer programs at advanced international levels. Microcomputers have limited capabilities and small capacities. The use of small equipment for large programs was an extremely difficult topic. They repeatedly debugged more than 10 programs and worked hard for half a year. In the end, they were the first in the nation to complete this type of adaptation and development work. After being tested in electric power departments within the country, it greatly improved the problem-solving capabilities of small and microcomputers. Large problems which in the past could be solved only with large computers can now be solved using microcomputers. Moreover, the results of the calculations are reliable and accurate and the computing time involved reached advanced domestic levels.

Han Zhenxiang, who is 53 years old this year, is a well-known electric power specialist in China. He graduated from the Electrical Machinery Department at Zhejiang University in 1951 and has been active in the forefront of applications and research for many years. At the beginning of the 1970's he

successfully developed a series of applied software for the electric power system. He formulated several large programs including "Calculation of Trends in Electric Power Systems", "Calculation of Stoppages in Electric Power Systems", "Calculation of Electric Power System Stability", and others that made major contributions to the safe and economical operation of electric power systems. At the beginning of the 1980's, he carried out research with other comrades on the automatic control of electric power systems using electronic computers and achieved many important successes. This opened up vast vistas for computerized control and regulation of the electric power industry in China.

On the foundation of practice, Han Zhenxiang continually used his new knowledge to enrich theory and published a series of scholarly articles in domestic and foreign academic journals. His several-hundred-thousand-word book, "Automation of Electric Power Systems", is a commonly-used textbook in colleges and universities. He participated in editing a book on "Electric Power Systems Calculations" that received a national award as a superior scientific and technical publication.

In addition to being closely involved in his administrative work as president of Zhejiang University, Han Zhenxiang is still earnestly engaged in scientific research. He has spent most of his Sundays in the laboratory after taking over as president. The 100,000-word book on "Safe Operations in Electric Power Systems" which he just completed also was written in his spare time.

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CSO: 4013/157



## HYDROPOWER

### EXPERTS FAVOR HYDROPOWER AS FASTEST WAY TO EASE SICHUAN'S ENERGY SHORTAGE

Chengdu SICHUAN RIBAO in Chinese 29 Feb 84 p 1

[Article by Chen Yikun (7115 0001 0981): "SICHUAN RIBAO Invites Experts To Offer Views on Resolving Sichuan's Energy Problems"]

[Text] The editorial department of SICHUAN RIBAO invited professors, experts, and researchers to express their views on resolving Sichuan's energy problems in a meeting held on the morning of 27 February. They were asked to propose solutions to achieve the goals of elevating Sichuan's position as well as the people's economic situation as set forth in the Twelfth People's Congress. At the meeting the following participants expressed valuable opinions: The deputy director and engineer of the Chengdu Methane Research Laboratory Xu Yizhong [6079 5030 1813], the deputy director and assistant researcher Gao Yutian [7559 1342 1131] of the Institute of Industrial Economics of the Sichuan Institute of Social Sciences, the director and senior engineer Wang Linxun [3769 7792 3800] of the Southwest Institute of Electric Power Design, senior engineer Qian Hao [6929 3185] of the Sichuan Textile Bureau, the director and professor Hu Ding [5170 1353] of the Rock Mechanics Program of the Chengdu Science and Technology University, the deputy Chief Engineer and Senior Engineer Hu Zhengli [5170 2973 4409] of the Sichuan Bureau of Water Conservancy and Electric Power, and Associate Professor Zhu Jiashou [2612 0094 1108] of the Chengdu Institute of Geology.

As pointed out by comrades Gao Yutian, Wang Linxun, and Hu Ding, Sichuan has more hydropower resources than any other province but only a small portion has been developed and the potential is still great. An important issue in Sichuan's future economic development is how to fully utilize this natural resource. The development of hydropower should be given a high priority in terms of capital investment and technical resources. Since the construction of hydropower stations takes a long time and power generation by runoff hydropower stations is limited by the low water season, the development of coal production and thermal power should not be allowed to slide while a major effort is devoted to the development of hydropower to meet the needs of short-term energy demands in economic development of hydropower to meet the needs of short-term energy demands in economic

development. In the long run, nuclear energy should be considered. The development of energy resources should be diversified and practical and the laws of nature and the laws of economics should be followed in order to achieve mutual complementary and rational utilization of resources. They suggested that a long-term plan be established for the overall investigation of energy development.

They also proposed that the funds needed in energy development, in addition to coming from the central government, may also be raised locally through a number of different means including preferential supply of electric power by the power stations and profit sharing.

Comrades Wang Linxun and Qian Hao believed that on the one hand there is a shortage of energy supply in Sichuan but on the other hand there is a serious waste of energy in the province. The thermal efficiencies of many industrial boilers and furnaces are far below the advanced standard and in the utilization of the electrical power the practice of "pulling a small cart with a large horse" prevails. In the past, large energy consumers were asked to conserve, but many smaller energy consumers still pay little attention to conservation. In the area of conservation, not only should we promote new conservation techniques, some necessary administrative measures and corresponding economic measures should be adopted as well. For example, the price of electrical power should be different during the high-water season and during the low-water season, and also different for the peak and valley load periods. Energy consumption quotas should be adhered to strictly and the price should be increased when the quota is exceeded. In addition, certain seasonal enterprises may also be established to make specific use of electrical power during the high-water season.

They also pointed out that irrational energy usage structures should be changed and the practice of wasting great quantities of natural gas for industrial fuel should be halted as soon as possible. Natural gas should be first used as a chemical industry raw material and by urban residents so that the urban gasification problem may be resolved.

Comrades Xu Yizhong, Hu Zhengli and Zhu Jieshou pointed out that methane and small hydropower stations are important energy sources in the vast rural areas and their roles in elevating Sichuan's economic status cannot be ignored. Methane gas is not only an inexpensive source of energy but also provides a multitude of advantages including environmental improvement and increases the efficiency of fertilizer. Sichuan had an early start in methane development and has accumulated considerable experience. But because many local areas could not properly deal with the past mistakes of pursuing quantity and ignoring efficiency, methane development waned and construction stagnated or lost ground. As to the development of small hydropower stations, the problem at hand is mainly the coordination of large power grids and small power grids in order to rectify the flaws existing in the construction and management system. The responsible leadership and department should place more attention on the development of methane gas and small hydropower stations, establish a development plan,



consolidate experience and make full use of existing technical results to promote a healthy growth in these two areas so that they may complement each other in providing new energy sources for the villages and in meeting the needs of large-scale development in commodity production and the construction of a new rural economy.

Comrades of the Methane Research Program are willing to sign contracts to develop methane gas in rural areas.

9698

CSO: 4013/145

## HYDROPOWER

### ACCELERATING CONSTRUCTION OF HYDROPOWER BASE ON UPPER COURSE OF HUANG HE

Beijing KEXUE SHIYAN [SCIENTIFIC EXPERIMENT] in Chinese No 3, 10 Mar 84 pp 4-5

[Article by Chen Shangkui [7115 0006 1145]]

[Text] The construction of a hydropower base on the upper course of the Huang He is an important part of China's short-term energy development plans. The construction of a series of hydropower stations on the Huang He is one of the three large projects in the program and will make it possible to satisfy the electrical needs of industry, agriculture and livestock raising in China's vast northwest and to supply abundant cheap power to northern China and to Beijing and Tianjin Prefectures.

#### Upper Course of Huang He Is Rich Source of Hydropower

Because of frequent disastrous flooding on the Huang He during the past 100,000 years, the river has become a popular symbol of disaster. In fact, the Huang He is also a rich source of energy.

The Huang He has its western source in the plateaus of Qinghai Province in Xizang and flows east to the Bohai Sea over a distance of 5,464 km. With a total drop of more than 4,800 meters and an average annual discharge of 56 billion cubic meters, this surging torrent can serve as a rich source of energy. According to surveys, the mainstream of the Huang He is capable of providing a total of up to 30 million kW of hydropower. Most of this potential energy is distributed over two sections on the upper and middle courses between the Maquxia and Qingtongxia and between Hekou Zhen and Huayuankou, which respectively account for 53.9 and 32.1 percent of the mainstream power. Energy is particularly plentiful between Longyangxia in Qinghai and Qingtongxia in Ningxia. Within this 900-km stretch of river, the average discharges through Longyangxia and Qingtongxia are 640 and 934 cubic meters per second, respectively. The river has a natural drop of over 1,400 meters, corresponding to an average head in excess of 140 meters per 100 km. Thus the average potential energy per kilometer exceeds 10,000 kW and is concentrated to an extent seldom achieved on big rivers. Much of this section of the river flows through sparsely populated areas between barren hills and canyons, and its banks are very steep. There are more than 20 locations where the geological conditions are favorable and the river

bed consists mainly of granite, sandstone and gneissic quartz suitable for the construction of large hydroelectric dams.

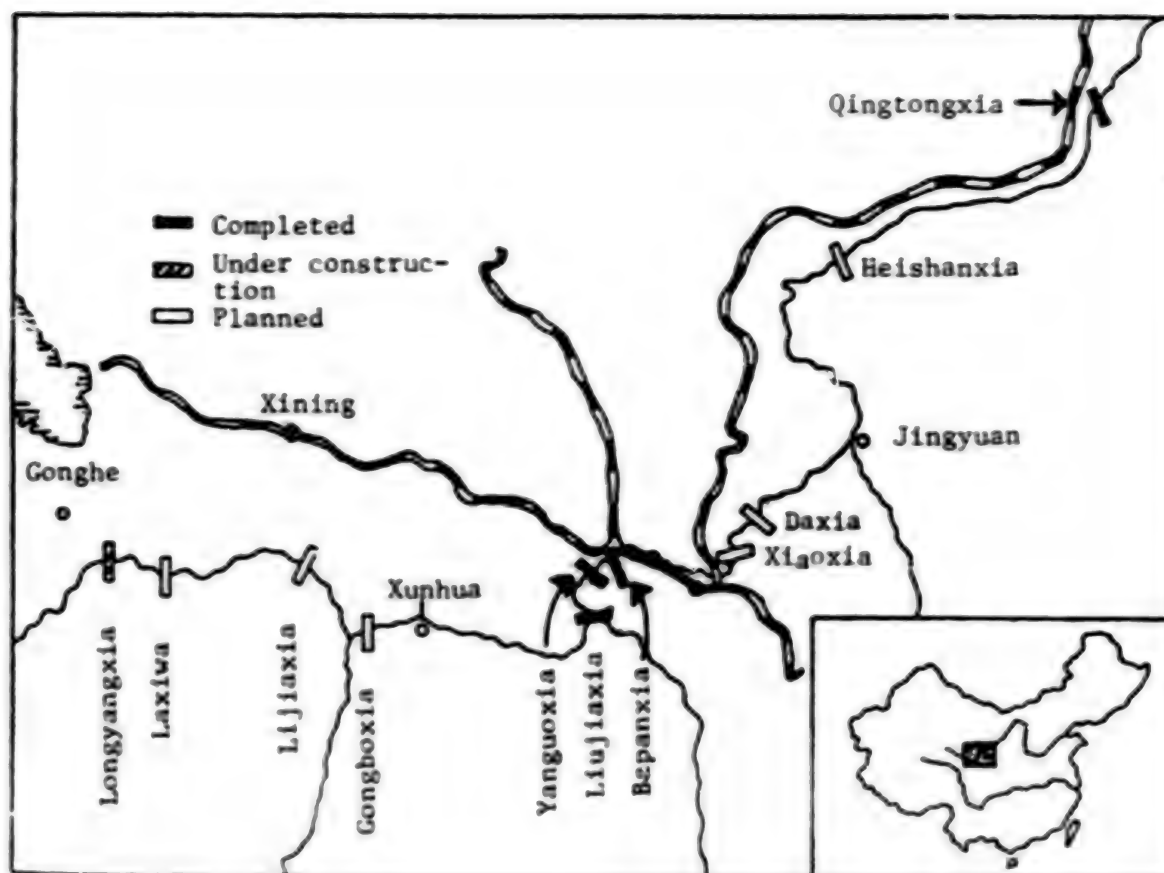
The [then] Ministry of Water Conservancy and Power began to study the hydroelectric development of the Huang He shortly after the founding of the PRC. The Huang He Planning Commission organized a large number of surveyors, planners, engineers and technicians in related areas. Numerous hydrological and geological tests were carried out and core samples were analyzed. This work culminated in the 1954 "Report on Economic and Technological Planning for the Comprehensive Utilization of the Huang He" which concerned the development of the upper course of the Huang He between Longyangxia and Qingtongxia, and the importance of electric power development in the comprehensive utilization program was stressed. Since then, many other plans and dam sites have been proposed. Further progress in planning the development of the upper Huang He was made during a general examination of hydropower resources throughout China from 1978-81. According to these plans, 15 cascade hydropower stations were to be constructed from Longyangxia to Qingtongxia. The projected installed capacity was to be 12.329 million kW, capable of generating an average of 50 billion kWh per year. This amount of energy is equivalent to that which would be obtained by building 10 1-million kW coal-burning power plants and constructing 10 large coal mines with an annual output of 3 million tons of coal. Thus the economic advantages of deriving this energy from hydropower are clear.

#### Four Power Stations Already Constructed

The first step in developing hydropower stations on the upper course of the Huang He was taken in 1958. During the 20-odd years since then, four stations have been constructed at Yanguoxia, Liujiaxia, Qingtongxia and Bapanxia. These four stations have transformed industry, agriculture, and livestock raising in the four provinces of Shaanxi, Gansu, Qinghai, and Ningxia.

The station at Liujiaxia is the largest in the series. It is located at Shensui Xia, which lies in the mountains 100 km to the west of Lanzhou. Its 147-meter-high dam with silver-gray concrete walls cuts the roaring rapids of the Huang He in two to form a large reservoir 5.7 billion cubic meters in volume. Electricity is generated by five large turbines which give an installed capacity of 1.225 million kW, corresponding to an annual average of 5.7 billion kWh of electrical energy. The first generator at the Liujiaxia station began operating in 1969, and by 1975 all five generators were in full operation. The Liujiaxia station was China's first large station with a capacity exceeding 1 million kW.

The installed capacity is 352,000 kW at the Yanguoxia station located 31 km downstream from Liujiaxia. The Yanguoxia was the first large hydropower station on the Huang He (work began in 1958), and its construction required the least amount of time--the first generator began operating after only 3 years and the station was completely finished in 1970. The Bapanxia station is 17 km downstream from the Yanguoxia and has an installed capacity of 180,000 kW. Construction began in 1969, the first generator was put into operation in 1975 and the last generator was installed in 1979.



The Qingtongxia hydropower station is located in the Ningxia Autonomous Region populated by the Moslem minorities. Its dam makes comprehensive use of the available resources by providing both irrigation and hydropower. The seven turbine generators installed in the power plant have a total capacity of 272,000 kW; the irrigation system draws water at a rate of 560 cubic meters per second by means of two aqueducts and irrigates 5 million mu of farmland on both banks of the Yinchuan and Huang He.

The total installed capacity of the Liujiaxia, Yanguoxia, Bapanxia and Qingtongxia stations on the Huang He is 2,029 million kW. This hydropower system was constructed rather quickly at relatively little cost. By the end of 1982, the system had generated a total of more than 90 billion kWh worth more than 4 billion yuan, or 3.4 times more than the total cost of the four stations. The generated power is transmitted eastward to Xi'an and westward to Xining and contributes significantly to China's northwest grid.

#### Transmitting Power from West to East

In order to speed up the development of energy resources on the upper course of the Huang He, the Longyangxia power station is currently under construction, and several other stations--Lijiaxia, Laxiwa, Gongboxia, Daxia and Heishanxia (or Daliushu)--are in the active planning and surveying stages.

The Longyangxia is the control station for the power-generating cascade on the upper course of the Huang He. It is the primary power station but is also involved in irrigation, flood control and the prevention of ice formation. It is thus engineered to make comprehensive use of the available resources and deliver various economic benefits. The Longyangxia station is situated in Gonghe County in the southern foothills of the Riyue mountains in Qinghai Province, some 140 km from the city of Xining. The Longyangxia valley is approximately 40 km long and has a 225-meter drop. In this region the Huang He cuts through steep cliffs rising at an angle of 70-80 degrees, and the river is only 30-40 meters wide during periods of normal rainfall. The upper course covers an area of 131,420 square kilometers and the annual discharge is 20.2 billion cubic meters. A concrete gravity arch dam 357 meters long and 178 meters high (China's largest at present) is now under construction in this deep valley. The completion of this tall dam will create a giant reservoir 24.7 billion cubic meters in volume on the upper course of the Huang He. This capacity is equivalent to one-third the capacity of the Qinghai Hu, China's largest saltwater lake, and exceeds the annual discharge from the upper reaches of the Huang He. It will be China's largest reservoir. The Longyang station will be equipped with four of China's largest turbine generators with a capacity of 320,000 kW, giving a total installed capacity of 1,280,000 kW and an annual energy output of 6 billion kWh. Under the control and regulation of the Longyangxia reservoir, the Liujiaxia, Yanguoxia, Bapanxia and Qingtongxia stations already constructed farther downstream will produce more than 500 million kWh per year and in addition the middle and lower reaches of the Huang He will be protected against flooding and icing. This will result in efficient utilization of hydropower in industry and agriculture and will produce a net increase of 14.91 million mu of irrigated land area and a net increase of 470 million cubic meters of water available for use by cities and industry. The plans for constructing the Longyangxia station called for the excavation of 14,870,000 cubic meters of earth and rock and the pouring of 3,220,000 cubic meters of concrete. Work on the generating equipment began in 1976 and construction of the main body of the station started in 1978. The river was dammed in 1979. The pouring of the concrete for the large dam was in full swing a year ago, and the base of the dam was completely covered by the end of June. The first generator is scheduled to begin operation in 1985.

The plans for the Liujiaxia station are on a larger scale than for the Liujiaxia and Longyangxia stations and call for an installed capacity of 1.6 million kW (5.8 billion kWh per year). The dam is to be located in Qinghai Province near the border between Hualong and Jianzha counties 55 km north of Xining by air. The distance from its upper course to the river at the Longyangxia station is 108 km, and the lower course is 225 km from the Liujiaxia station. The terrain is similar to that at the Longyangxia station; the river cuts a rather deep V-shaped path through the mountains and the banks rise some 200-300 meters above the water surface. Preliminary plans for this station are now underway. Another station is also being planned at Laxiwa, which is 5 km distant from the outlet of the upper course of the river at Longyangxia. The river is narrow--only 30-50 meters wide--the banks are high and precipitous, and the top of the mountain rises approximately 700 meters above the water surface. A large dam more than 200 meters



high with an installed capacity perhaps exceeding 3 million kW is planned for Laxiwa. With an annual output of 9.4 billion kWh, it will be the tallest dam and the largest hydropower station on the Huang He. Preliminary surveying work is now in progress. The Gongboxia station lies within the borders of Xunhua County in Qinghai Province; its installed capacity is to be 1 million kW, for an annual energy output of 4.1 billion kWh. The Daxia station is to be located in the northeast part of the city of Lanzhou in Gansu Province and will have an installed capacity of 300,000 kW. The Heishanxia station (alternatively, the Daliushu station) will be located in Jingtai County in Gansu Province (the Daliushu will be in Zhongwei County in Ningxia Province). The plans call for constructing a large reservoir approximately 10 billion cubic meters in capacity. The installed capacity of the station will range from 1.2 to 1.4 million kW and the annual energy output will be from 4.7 to 6.6 billion kWh. This station will also be comprehensively provided with irrigation, anti-icing and other facilities.

The straight-line distance from Taiyuan in Shanxi Province to the Longyangxia, Lijiaxia, Laxiwa and Heishanxia stations forming the hydropower base on the upper course of the Huang He ranges from a maximum of over 1,000 km to a minimum of only a few hundred km. Once this system has been constructed in stages, the northwestern and northern grids can be connected to form a large single grid in northern China capable of transmitting power from west to east. Although northern China has abundant supplies of coal, hydropower resources are very unevenly distributed. Indeed, Shanxi Province and the autonomous region of Nei Monggol alone contain more than 60 percent of China's coal reserves, but hydropower is lacking throughout north China, which has just 1.8 percent of China's total hydropower resources. This is particularly true of Beijing and Tianjin and of Hebei Province, which are endowed with only 0.3 percent of China's hydropower resources. The joining of the northwest and northern grids will permit the northwest to export its excess power to Beijing and Tianjin Prefectures and will make full use of its rapidly-switched power-generating equipment to add power to the grid to satisfy peak loads, regulate the AC frequency, supply reserve power in case of accidents, etc. It will also be possible to exploit the time difference between eastern and western China to stagger the peak load periods, use hydropower and electricity generated by burning fossil fuels to supplement one another and enhance the economic effectiveness, safety and reliability of grid operation.

#### Difficulties and Benefits

The hydropower base on the upper Huang He is located in sparsely settled plateaus and gorges, where flooding losses are minor and engineering difficulties are few. There will be no losses due to flooding at the Daxia station, and flooding losses at the Laxiwa station will be extremely small. One of the great advantages of constructing the proposed system of stations is that there are few other regions in China where a 3 million-kW station like Laxiwa would flood only 200 mu and require the relocation of only 90 people. Nor is silt a serious problem on the upper Huang He, in contrast to the middle reaches of the river. Most of the 1.6 billion tons of silt carried each year by the Huang He originates in the loess plateau of Shanxi

and Shaanxi Provinces; during the high-water season, each cubic meter of water at the Longmen hydrological station contains an average of 50 kg of silt, and the silt content can be as high as 900 kg. By contrast, the vegetation on the upper course of the Huang He is of good quality--a cubic meter of water at Longyangxia averages 1.1 kg of silt, and 24.4 million tons of silt are transported annually (the corresponding figures for Heishanxia are 5.5 kg and 182 million tons). Serious silt deposit problems, such as those which afflict the reservoir at Sanmenxia and prevent water storage, thus cannot occur. The principal difficulties in constructing the series of stations on the upper Huang He are caused by the fact that communications are difficult; the land is high and cold (2,600-2,700 meters above sea level) and subject to duststorms; living and working conditions are harsh, and construction is relatively difficult. However, the engineers and technicians responsible for constructing the Longyangxia hydropower station are in the process of overcoming all sorts of difficulties and are gaining experience in building stations in the highlands.

12617

CSO: 4013/124

## HYDROPOWER

### EXPANDING ROLE OF SMALL-SCALE HYDROPOWER IN FUJIAN

Fuzhou FUJIAN RIBAO in Chinese 12 Jan 84 p 3

[Article by Huang Bairong: "Strive To Succeed in Small-Scale Hydropower Development"]

[Text] Small-scale hydropower has become an important part of the electric power industry of Fujian Province. Fifty-nine counties have now established small-scale hydropower networks to unify the management of electricity generation and supply within their jurisdictions. The capacity of small-scale hydropower stations has expanded several hundred-fold. Single stations that once served local areas are now part of integrated operations under unified control that supply electricity over long distances. In the development of small-scale hydropower, the old emphasis was on runoff; today, we stress building and regulating reservoirs, gradually increasing the proportion of electricity. Small-scale hydropower plays an essential role in ensuring a reliable safe supply of electricity and in improving economic results. It marks the dawn of a new era in the development of small-scale hydropower in the Province.

Despite the progress it has made, small-scale hydropower still faces some problems. Among the existing stations, utilization tends to be low at times and electric power networks lack rational planning. Some networks are structurally weak and the incidence of network damage is high. To further improve the economic value and reliability of small-scale hydropower, therefore, is management's main task in the future. The following measures may serve this purpose:

1. Developmental planning and preliminary work must be carried out seriously. Whether we are talking about the development of a river or the layout for an electric network, we must first conduct in-depth research and investigations, make empirical comparisons, and choose the best alternatives under the principles of integrated utilization. As much as material resources allow, we must work out a schedule to phase in a project. Henceforth, small-scale hydropower plants should follow the same procedures governing capital constructions. Before construction can begin on a county-managed key project, a plan must be drawn up, a location selected, design documents properly prepared, capital and resources secured, outlets for electricity verified, and permission obtained for inclusion in the annual plan. This procedure is the most crucial step towards obtaining economic results.



2. Strengthen the management of existing local electric power enterprises. After turning over to the central authorities the Province's large and medium-sized electric power enterprises, Fujian would still keep 800,000 kW of small-scale installed capacity and 30,000 kilometers of high tension transmission lines. Both the Province and the counties should set up their own local electric companies to run this large number of enterprises, strengthen their management, work out their relationship with the affiliated networks, and make the most of large and small electric networks. Small-scale hydroelectric networks should also be reorganized by stages to establish or perfect various rules and regulations, upgrade the quality of electricity, and improve service to achieve "safety, economy, maximum availability, and minimum losses."

3. We must remold the conveyance systems in a planned way in order to tap their potential and increase the productivity of existing works. The storage capacity of runoff power stations must be maximized to increase the ability of networks to modulate frequency during periods of peak demand and ensure a safe, reliable electricity supply. Networks must be reorganized gradually by increasing the necessary communications, protection, and compensation installations, and reducing losses during transmission and transformation. We must strengthen regulating and economizing measures, determine optimal operating procedures, and charge flexible rates for electricity depending on seasonal and demand factors so as to maximize utilization.

1258

CSO: 4013/104

## HYDROPOWER

### SICHUAN'S SMALL-SCALE HYDROPOWER PILOT PROJECTS SAID SUCCESSFUL

Chengdu SICHUAN RIBAO in Chinese 21 Jan 84 p 1

[Article by Xiang Degui [0686 1795 6311]: "Pilot Counties for Sichuan Rural Electrification Step Up Pace of Small-Scale Hydroelectric Power Construction"]

[Excerpts] Last year, 10 counties in Sichuan--Dayi, Guanxian, Emei, Suining, Pingchang, Dazhu, Wenchuan, Yingjing, Hongya, and Xuyong--designated by the State Council to be among a hundred pilot counties nationwide for rural electrification, plus the provincial pilot counties of Ganluo and Yanbian, with the assistance of the departments concerned, actively drew up plans, vigorously promoted construction in electric power sources and networks, expanded the scope of rural electrification, and achieved notable results. Early last year, in accordance with the views of the leading comrades of the central authorities, the departments concerned at the national level selected a hundred counties from provinces and areas rich in hydroelectric power resources, including 10 counties in Sichuan, to serve as pilot counties to meet the basic demands for rural electrification within a set 5-year period. Sichuan has held many meetings to study how to conduct pilot county work and the provincial government has set up rural electrification leadership groups. The provincial Hydroelectric Power Office in charge of small-scale hydroelectric power construction, has brought the conditions of the pilot counties up to rural electrification standards. Each pilot county also set up rural electrification leadership groups and with the assistance of the departments concerned at higher levels, organized forces to draw up plans. By 1987, it is estimated that for the 12 counties (including the two pilot counties under the auspices of the province), small-scale hydroelectric installed capacity will increase more than 100 percent over 1982. Households with electricity will expand from 51.54 percent to 91.45 percent, and, during periods when water is plentiful, 22 percent of the households will cook with electricity; per capita use of electricity will increase 3.67-times, agricultural by-products processing will basically be powered by electricity, electricity for agricultural production will be greatly increased, and the electricity needs for county and commune industrial development will be basically met. The average per capita total annual amount of electricity available will be 168.8 kilowatt-hours, a 2.18-fold increase.

Being responsible for both plans and operations, each pilot county raised its own funds, resolutely pushed the construction of electric power sources and networks, vigorously expanded the power load for rural areas, and broadened the scope of rural electrification. Last year alone, Yingjing County started building seven new small-scale hydroelectric power stations, some of which were finished and put into production. Pingchang County raised its own funds to string transmission lines and by the end of last year had provided electricity to over 63 percent of its peasant households. The counties of Emei, Dayi and Guanxian made comparable progress in new power source construction and power network facilities.

While strengthening the leadership of the pilot counties, each locality stepped up the pace on small-scale hydroelectric power construction. Last year, small-scale hydroelectric power installations throughout the province provided 50,000 kilowatts, electric power production increased more than 20 percent over 1982, and production teams with electricity increased from last year's 33.7 percent to more than 40 percent. Many small-scale hydroelectric power plants underwent administrative reforms and greatly improved their economic results. Recently the provincial Hydroelectric Power Office held a province-wide local electric power work conference to study problems of small-scale rural hydroelectric power construction in the pilot counties and throughout the province.

7755

CSO: 4013/100

## THERMAL POWER

### SHANXI TO BUILD BIG PIT-MOUTH POWER PLANT AT HEJIN

Taiyuan SHANXI RIBAO in Chinese 20 Mar 84 p 1

[Article]

[Text] At the request of the State Planning Commission, the North China Power Management Bureau of the Ministry of Water Resources and Electric Power recently convened a preliminary feasibility study and investigation meeting concerning the Hejin power plant and approved the preliminary feasibility study report on the Hejin power plant as proposed by the North-west Electric Power Design Academy.

The Hejin power plant is another large pit-mouth power plant which uses primarily washed medium-grade and inferior coal as fuel. The plant is bordered on the north by the HedongXiangning coal field and on the west by the Huanghe-Yumen basin. It is adjacent to the Houma-Xi'an Railroad and near the Shanxi Aluminum Plant. There are abundant coal and water resources, easy communications and other superior conditions for plant construction. The scale of construction is 2.4 million KW.

The Hejin power plant is among 279 key projects slated for construction during the first part of the Sixth Five-Year plan. It will be built in coordination with another key state project, the Shanxi Aluminum Plant. The plants will directly serve the Hejin metallurgical and energy resources base area, which focuses on aluminum and coal. This plant is now in the stage of preliminary feasibility studies. The drilling rigs are now on-site and preliminary work in hydrogeology, engineering geology, climatic testing, low-altitude air current testing and other areas is being speeded up. It is estimated that construction will begin formally in 1986.

12539

CSO: 4013/169

## COAL

### GAO YANGWEN ON DOUBLING COAL PRODUCTION

HK010703 Beijing LIAOWANG in Chinese No 20, 14 May 84 pp 11-12

[Article by Huang Fengchu [7806 1144 0443] and Chen Hongyi [7115 1738 3025]: "Advance Toward the Target of an Annual Output of 1.2 Billion Tons of Coal--An Interview With Gao Yangwen, Minister of Coal Industry"]

[Text] In the world today, economically developed and developing countries all face the problem of energy resources. The rate of the development of energy resources will have a direct bearing on the rate of economic growth. By the end of this century, our country is to realize the magnificent target of quadrupling the gross annual output value of industrial and agricultural production, with coal as the chief energy resource.

How are we to ensure the demand for coal is met? With this question in mind, the reporters visited Gao Yangwen, minister of coal industry.

The interview took place in the minister's office. Gao Yangwen told us: The energy resources of our country are coal in the first place, and hydro-electric power in the second. Although it is necessary to develop oil in a big way, it is mainly a raw material for the chemical industry and for export. It is also necessary to develop nuclear power as a supplementary energy resource for regions short of coal. According to the demand for coal in the four modernizations, the objective in the field of coal production is to raise the annual output of coal to 1.2 billion tons by the end of the century on the basis of the present annual output of 600 million tons. Only then will we be able to ensure the quadrupling of the annual gross output value of industrial and agricultural production of our country.

Gao Yangwen said: "The task is arduous." He made the following calculation: It took a whole three decades for China to raise the annual output of coal from 32 million tons in the early years after the founding of the PRC to the present annual output of 600 million tons. Our current task is, in the 18 years from the day the CPC 12th National Congress proposed the target to the end of this century, to cover a distance completed in the past 3 decades--to achieve an increase in the annual output of another 600 million tons.

"How is the Ministry of Coal Industry to fulfill the task of doubling the output of coal?"

The minister did not answer our question directly, but said: "The CPC 12th National Congress has listed energy resources as one of the strategic keys in the economic development of our country. Comrade Hu Yaobang has also pointed out that energy resources are the lifeline in realizing the four modernizations of our country. The Party Central Committee and the people of the whole country are waiting for a response from us." He briefed us on some basic information: Today, we have a better idea about the conditions of the coal resources of the whole country. At present, the coal deposits of the whole country which have been surveyed account for 770 billion tons, and the prospective deposits are still more impressive. Over the past 3 decades and more, coal has been excavated fast north of the Chang Jiang, the majority of the mining has been concentrated in Shanxi, Henan, Hebei, Shandong, Heilongjiang, Nei Monggol and so on. However, resulting from the limitation of our transportation capacity, the coal which has been excavated fails to be shipped out of the areas of production, and there has been little development in production in recent years. Places most developed in our country such as Shanghai, Jiangsu, Zhejiang, Guangdong, Liaoning, Beijing, and Tianjin have a great demand for coal, but because of insufficient transportation capacity, we have failed to satisfy their demand, affecting the development of the economy and the growth of economic results. If the output of coal is to be doubled, it will face the problem of the distribution of the development of coal, and correspondingly, the problem of the allocation of transportation, and so on.

Gao Yangwen said: "People like us who are in coal production have had to bear great pressure, and we are having a bad time." He said: "Pressure comes from many areas, such as fluctuation in output, production accidents, and economic losses. However, the biggest problem remains that of transportation. Out of an annual output of over 600 million tons of coal, over 200 million tons never get delivered to other places because of transportation constraints. If we can ship a little more of the coal, say 10 million tons, it will bring the state taxes and profits of 2 billion yuan. And if this amount of coal is delivered to industrially developed places like Zhejiang and Shanghai, it will bring in a value of 4 billion yuan! This is by no means a small figure! We have been working closely with railway and transportation departments, busy every day solving problems in conveying coal; nevertheless, the problem of insufficient transportation capacity cannot be solved for the time being.

"Of course, we are materialists, we will face difficulties squarely, and we will march forward despite the knowledge that there are difficulties ahead, turning pressure into a motive force."

Originally engaged in CYL work, Comrade Gao Yangwen was transferred to the industrial sector during the time of the first 5-year plan. He had long worked in the metallurgical field until transferred to the Ministry of Coal Industry in December 1979, where he began to develop an understanding of coal, and then assumed leadership in coal production.



At that time, the coal industry system was implementing the policy on the readjustment in the national economy. There were two different views in the Ministry of Coal Industry: One held that imbalance had not been so serious, and readjustment should be carried out with the development of production; the other held that imbalance had been grave, and there should be a slowdown in production while readjustment was carried out. Which view was correct? This depended on whether the person in charge was able to make a correct strategic decision by linking the CPC Central Committee's principle with the realities of the coal industry. Over the past 3 decades and more, our coal production has grown very quickly. China has now become the third largest coal producing country in the world, next only to the United States and the Soviet Union. However, because of the mistakes in our work in the past 3 decades, there have appeared two major twists and turns in coal production. During the Great Leap Forward, because of "leftist" ideological influence, the annual output of coal dropped from 397 million tons to 220 million tons, recovering only in 1965. During the 10-year internal disorder, as a result of the interference and sabotage of Lin Biao and the "gang of four" counterrevolutionary cliques, the annual output of coal again fell.

The minister went on to say: "It was difficult for me to make a decision at that time. Any mistakes would bring losses to our practical work. I could do nothing but get myself moving and go down to the grassroots units, making investigations and studying among grassroots cadres, engineers, technicians, and workers. That was the only way out."

Bringing along with him only a light pack and a few aides, he went down to coal pits in mining districts, holding heart-to-heart talks with grassroots cadres, engineers, technicians, and workers. At the same time, he seized every opportunity to make contacts with personages in coal circles from all parts of the world, learning from them about the conditions of the coal industry abroad. In order to pool wisdom from all quarters, and to avoid mistakes in making a strategic decision, a "consultative group consisting of 100 people" was set up under his advocacy, giving counsel for the development of the coal industry. He acquired first-hand materials through a large amount of work in investigation and study. He came to an initial conclusion on the development of the coal industry in our country, namely, the growth in output should be comparatively stable, and should not be like it was in the past, with sharp rises at times followed by drastic falls; development should be comparatively healthy, not in any way like it was in the past, for which a big price was paid. Considerations should be given to better economic results of the enterprises, better effects in saving energy resources, and better comprehensive results for the state; by no means should we rest satisfied with having simply excavated the coal. Explicitly he pointed out: "Our principle is to carry out readjustment on the basis of stable output. Our central task is readjustment. It is imperative to stabilize the output of 600 million tons of coal, to step up the pace of readjustment and to raise the annual output gradually, under the premise of ensuring the situation of the whole." His advocacy has been accepted.

The practice in recent years has proved that the principle of readjustment on the basis of a stable output is comparatively conformative with the realities of coal production and economic law. Now some coalpits which were once suffering from grave dislocation in excavation have become normal in their production, there has been some improvement in the safety conditions, and there is improvement in the living facilities of workers and staff and educational facilities. The workers and staff are full of vigor, output has been growing steadily, and by the end of last year, the index stipulated in the Sixth Five-Year Plan was fulfilled 2 years ahead of schedule.

"What is your plan for the next step?"

He said: At present, the coal industry of our country is in a new stage of great development and great changes. We should not only increase quantity but also improve quality. This involves changing the present conditions, and the implementation of a series of reforms. At present, it is primarily necessary to grasp the changes in five aspects, they are:

--It is necessary to adopt new technologies, new techniques, and new equipment. Key coal mines of the whole country should shift from taking manual operation in the main to taking mechanized operation in the main.

--It is necessary to change the failure in controlling major accidents into basically keeping them under control, and to strive for basic change for the better in safety conditions in coal mines.

--It is necessary to change from producing a single product (raw coal) to producing varieties of products.

--It is necessary to change from using small tonnage railway rolling stock and small locomotives in hauling coal in the main to using heavy coal conveying trains, conveying coal by means of water transportation with various kinds of cargo vessels, automatic loading and unloading, supplemented with pipeline transportation and truck transportation.

--It is necessary to change the management of coal production with sole administrative measures to a combination of economic and administrative measures in the management of coal production.

"The actual conditions of China have indicated that in developing China's coal industry, it is imperative to walk on two legs, to simultaneously develop large, medium, and small enterprises, with the state, the collective, and the individual working in joint efforts. While developing those coal mines under the unified control of the state, it is necessary to adopt flexible measures to develop local coal mines in a big way, running mines by all professions and trades with self-raised capital funds of the masses. In particular, it is necessary to give a free hand to mobilizing the masses to run small coal pits, so that all the coal that can be excavated and put



to use will be excavated, making them do their bit for the four modernizations. These are the characteristics of China's coal industry, which fully conform to the state of affairs of our country."

With particular emphasis, Gao Yangwen said: "At present, energy resources in China are strained, which has affected the pace of the four modernizations. The CPC Central Committee has recently emphasized that it is imperative to enhance excavation in the coal industry; it is imperative to make underground natural resources "circulate" and to make them "circulate fast." We should give preference to arrangements in construction projects of expansion, renovation, and technological transformation, so as to fully tap the potential of existing coalpits. For old mines and coalpits which are abundant in coal resources and have convenient communications, in particular, mines and pits in the eastern part of the country, we should shorten their years of service correspondingly, intensifying their excavation, so as to relax the tense situation in the supply of energy resources.

"It is necessary to further do a good job in the processing and utilization of coal, including coal washing, processing into briquets, electricity generation with waste coal, and so on. This will create conditions for society to save energy, and will raise the economic results of the coal mines.

"At present, China is short of capital funds, which has limited the building of the coal industry, but actually, we can find capital funds. Many regions short of coal have money--they are required to run coal mines with collected capital funds--and foreign entrepreneurs are interested in investing in China in operating coal mines, in particular, opencut coal mines, so long as we earnestly implement the Central Committee's principle on opening up to the outside world, and pumping up the domestic economy, it will not be difficult to solve the problem of capital funds for the building of the coal industry."

With pleasure, Gao Yangwen made a sketch of the prospective distribution in the development of the coal industry: We will focus on developing the coal industry in Shanxi, building it into a base area of energy resources; at the same time, the coal industry in East China (Anhui, Shandong, and Jiangsu) will also be developed; it is necessary to appropriately step up the pace in the development of the coal mines in the three provinces in the northeast, Hebei, Henan, west Guizhou, and north of the Wei River; it is also necessary to step up the pace in developing the five major opencut coal mines in Huolinhe, Jungar, Yiminhe, Yuanbaoshan, and Pingshuo; and the large opencut coal mines in northern Shaanxi and Yunnan should also be prepared to be opened up to the outside world.

Here, the minister said in excitement: "What I mentioned above are only coalfields in the eastern and central parts of our country. The coal deposits in the western part of our country are all the more impressive, the farther west it is, the better. In the northern parts of Shaanxi and Ningxia, in the western part of Guizhou, and in Xinjiang and other provinces

and regions, natural resources are more abundant, and the quality of coal better. There are inexhaustable treasures buried underground, awaiting development. According to initial surveys, there are deposits of over a trillion tons."

"Another point to lay special stress on is," said Gao Yangwen, "that the development of large-type opencut coal mines is the strategic target for China's coal industry in the decade and more from now, and for the next century. An opencut coal mine will bring an output of over 10 million tons and sometimes 50 million to 100 million tons, which is tantamount to the total output of scores of coal pits with an annual output of 1 million tons. Such an opencut coal mine involves less investment and a shorter construction period making economic results faster..."

At this moment, his secretary pushed open the door, coming in to tell the minister that it was time to interview some foreign guests. However, Comrade Gao Yangwen was still in a mood for talking. He did not waste time in saying to us: "When we talk about changes, or reforms, the basic point is to grasp the training of talented people, namely, the investment on intellectual resources, because this is the most fundamental thing." He said figuratively: Our coal mine is like a big tree, its branches are exuberant, but its roots are not quite developed. Because of the backwardness in our education, a considerable number of workers and staff are low in their cultural and technical levels. It is precisely a matter of intelligence, very much like the moisture and nutrients in a plant. If the roots are underdeveloped, the supply of moisture and nutrients will fail, and the exuberant branches of the tree will wither!

The minister was up on his feet and said: "I am full of hope for the prospects in the development of China's coal industry, and I am full of confidence in doubling the output of coal by the end of this century."

CSO: 4013/181

## COAL

### SUCCESS IN USING STONE COAL TO GENERATE ELECTRICITY REPORTED

Beijing ZHONGGUO MEITAN 3AO in Chinese 7 Apr 84 p 1

[Article: "Stone Coal of More Than 900 Kilocalories Successfully Used for Power Generation--The Yiyang Power Generation and Comprehensive Utilization Plant Achieves a Breakthrough in Stone Coal Utilization"]

[Text] Successful results have been achieved in technologies which combine the utilization of stone coal for power generation and comprehensive utilization of boiler slag at the Yiyang Experimental Power Generation and Comprehensive Utilization Plant in Hunan Province. This has opened up a new route for development and utilization of stone coal in coal-deficient regions of the south.

The Yiyang Experimental Power Generation and Comprehensive Utilization Plant includes an open-pit mine which produces 300,000 tons of stone coal a year, a power plant with an installed capacity of 6,000 kW, a construction materials plant which produces 50,000 tons of stone coal slag cement and 5,000 cubic meters of cement products a year and a divanadium pentoxide plant with an annual output of 25 tons. Stone coal with a low thermal value of 950 kilocalories per kilogram is being used as fuel in the 35 tons of steam per hour ebullient boiler in the power plant. It is now capable of safe full capacity operation, and environmental controls meet national standards. The total on-line power generation time in the network was 12,213 hours from the trial firing in March 1978 up to the end of 1983. Power generation totalled 68.33 million kWh. During this period, it was in operation for 2,838 hours last year and produced 16.62 million kWh. The plan this year was to operate for 5,000 hours and produce 28.75 million kWh. Actual power generation for the first quarter was 1,776 hours with an output of 10.29 million kWh. The costs of power generation approximate those of single generator raw coal burning power plants of similar capacity. Profits last year totalled 49,000 yuan. Profits from the open-pit stone coal mine were 32,000 yuan. Profits in the construction materials factory that uses stone coal ebullient boiler slag for production of concrete block, common silicate cement and cement products last year totalled 135,000 yuan. Divanadium pentoxide was also successfully extracted from ebullient boiler ash, which has also been appraised.

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CSO: 4013/172

## COAL

### PROSPECTS FOR COMPREHENSIVE USE OF SOUTHERN STONE COAL SAID BRIGHT

Beijing ZHONGGUO MEITAN BAO in Chinese 7 Apr 84 p 1

[Article: "The South's Abundant Stone Coal"]

[Text] Stone coal is a flammable organic rock with a low thermal value and high ash content found in ancient strata before the Mid-Devonian era. It was formed by algae, fungi, and other primitive life forms under littoral conditions. Most of it is highly metamorphic sacropelic anthracite. Stone coal is distributed throughout 12 provinces (and autonomous regions) in southern China. Going from north to south, it may be divided into the Qinling, Yangzi, Jiangnan, and Dongnan stone coal belts. There were many formational periods for the stone coal in the Qinling belt and geological structures are complex. The coal is of high quality, however, and has a high calorific capacity, generally 4,000-5,000 kilocalories per kilogram. The Jiangnan belt has stable strata, broad distribution, and large reserves. The calorific capacity is low, however, primarily 800-1,200 kilocalories per kilogram. The Yangzi and Dongnan belts have scattered distributions, thin coal seams and low calorific value.

The south has abundant stone coal resources. There are 19.49 billion tons of it less than 100 meters deep and 38.48 billion tons of it from 100-300 meters deep. The greatest portion has a low calorific value, from 800 to 1,200 kilocalories per kilogram; 21.7 percent is in the range of 1,200 to 3,000 kilocalories, and an even smaller amount is over 3,000 kilocalories.

The stone coal is suited to open-pit extraction because it is buried in shallow, thick layers, most of which are 10 meters thick, the maximum being 157 meters.

Most of the stone coal has a low calorific value, but the comprehensive utilization value is high. There are substantial amounts of associated elements. Preliminary investigations have shown that there are 60 different useful elements associated with stone coal. Ten of them, including vanadium, molybdenum, copper, gallium, cadmium, uranium, silver, rare-earth, yttrium, and samarium, have industrial value. The most abundant reserves are of vanadium, with as much as 110 million tons. Minerals that were formed with the stone coal include phosphorous, potassium, pyrite, limonite, barite, asbestos, and anthraxolite. Potassium is an important industrial material, and proven reserves total 1.9 billion tons. The comprehensive development and utilization of the minerals associated with stone coal is just beginning and there are bright prospects.

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## COAL

### STONE COAL HELPS SOLVE SOUTH'S ENERGY SHORTAGE, PROMOTE INDUSTRY

Beijing ZHONGGUO MEITAN BAO in Chinese 7 Apr 84 p 1

[Article: "Comprehensive Utilization of Stone Coal in the South Is Underway"]

[Text] In recent years, China's southern provinces have rapidly developed comprehensive utilization of stone coal. Stone coal production in 1983 totalled 5.37 million tons. There has been an average annual production increase of 570,000 tons over the past 3 years. Stone coal has not only been used to alleviate energy shortages, but was also used to produce 750,000 tons of cement, 2.35 million tons of lime, nearly 1.7 billion building bricks and more than 200 tons of vanadium last year.

Comprehensive surveys have shown that there are abundant stone coal resources in southern China. Total reserves amount to 60 billion tons. Utilization of stone coal for total baking or partially-mixed baking of cement can promote liquid-phase generation, which is beneficial for clinker mineralization. Output is high while heat consumption and costs are low. All of the provinces south of the Chang Jiang have built stone coal cement plants. Zhejiang Province alone has 57 such plants, with an annual output of 500,000 tons and profits of about 10 million yuan.

The use of stone coal for baking lime is even more common. According to incomplete statistics, output in the provinces south of the river reached 2.35 million tons. In Zhejiang, annual output was 1.3 million tons, equal to 85 percent of total provincial production. Some 570,000 tons of raw coal or 2.35 million tons of firewood can be saved each year. This benefits coal conservation and the protection of forest resources.

Stone coal slag and stone coal ebullient boiler slag used for production of carbonized brick or boiler slag brick has now reached 530 million bricks, and stone coal used for production or internally-fired brick has now reached 1.15 billion bricks. According to model investigations, there was a profit of 150 yuan per 10,000 carbonized bricks and 80 yuan per 10,000 internally-fired bricks. Large amounts of construction materials have been supplied to urban and rural areas.



In recent years, six stone coal vanadium plants have been built in the provinces south of the Chang Jiang with a total scale of 400 tons. More than 200 tons of refined vanadium were produced last year. It is being sold at home and abroad with a profit per ton of over 2,000 yuan.

Comprehensive utilization of stone coal has made up for energy shortages in coal-deficient regions and has promoted development of local industries. Zhuxi and Zhushan counties in Hebei are located in a mountainous region in the northwestern part of the province. Wood was the main household fuel in the past. There has been substantial development of stone coal usage in recent years. Stone coal now supplies half of all household fuel and saves 15,000 cubic meters of wood a year. Zhuxi County is using stone coal to make gas for production of synthetic ammonia. This has provided effective assistance to agriculture. Shuangpai Commune in Lanxi County, Zhejiang Province, produces 30,000 tons of stone coal a year. Stone coal is used as fuel or a raw material in 12 enterprises, with annual profits of 600,000 yuan. The enterprises have provided 1.97 million yuan have provided for farmland water conservancy construction and for development of agricultural and sideline production in the past few years.

In addition, new achievements have been made in experimental research in such areas as stone coal refining and in the dressing and recovery of refined sand sulfides.

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## COAL

### BIG FUTURE SEEN IN USE OF GANGUE TO GENERATE ELECTRICITY

Beijing GUANGMING RIBAO in Chinese 23 Apr 84 p 2

[Article by Xiao Shi [5135 1395]: "Bright Prospects for Using Gangue To Generate Electricity"]

[Text] Leading comrades in the State Council recently pointed out that tests in several places have shown that the utilization of gangue for electricity generation is technically feasible. Measures should be adopted to encourage and assist coal mines to actively extend its use. We feel that this is an important measure for solving the energy shortage in China. If it is done on a large scale, it not only can make large amounts of electricity and coal available to meet urban needs, but can also control environmental pollution, thereby providing multiple benefits. For this reason, related departments should earnestly study it and organize its implementation.

#### 1. The Use of Gangue for Power Generation Can Turn a Bad Thing Into A Good One

The nation's unified distribution coal mines now have more than 1 billion tons of gangue on hand, covering more than 50,000 mu of land. The current coal production level of more than 600 million tons per year means that over 100 million tons of gangue are added annually. More than 15 million tons of this gangue has a calorific value greater than 1,500 Kilocalories per Kilogram. This is equivalent to about 5 million tons of standard coal. Coal departments now use more than 120 billion kWh of electricity per year, equal to an installed power generation capacity of 2.4 million KW requiring 7.2 million tons of coal. If the needed investments are made to build a series of 1.4 million kW gangue-burning fluidized-bed boiler power plants at unified distribution coal mines having the proper conditions within the next 5 to 7 years, then 15 million tons of gangue can be used to generate 7 billion kWh of power each year. This will conserve 5 million tons of raw coal. The benefits are obvious.

#### 2. The Use of Gangue for Power Generation Is Technically Feasible

The situation at several coal mines in Hunan, Sichuan, Jiangxi, and Heilongjiang provinces that generate power using gangue-burning fluidized-bed boilers has shown that the technology is feasible and the results are fairly good.

The Yiyang Experimental Stone Coal Power Plant in Hunan, for example, burns gangue with a calorific value greater than 900 Kilocalories per Kilogram and has installed a 35-ton-per-hour fluidized-bed boiler fitted with a 6,000 kW generator. It can operate continuously for 1,000 hours. It is now a fluidized-bed boiler with a fairly large capacity that uses the lowest calorific value fuel and has operated stably for a long time.

Another example is the Sichuan Yongrong Mine Service Bureau. Beginning in 1975, they invested 800,000 yuan and converted four old-style boilers into gangue-burning fluidized-bed boilers. The thermal efficiency of the boilers increased from 55 to 78 percent and the cost per 1000 kWh fell from 118 yuan for coal-burning to about 52 yuan. From 1976 to 1982, they conserved a total of 236,000 tons of raw coal, saved a substantial amount in electricity fees, turned over 10.6 million yuan in profits and reversed a long-term deficit situation.

Yet another example is the Pingxiang Mine Service Bureau in Jiangxi that produces more than 3 million tons of coal per year and now has more than 24 million tons of gangue covering 200 mu. They invested 14.3 million yuan in 1979 and completed construction on a power station with two 6,000 kW generator sets fitted with two 35-ton-per-hour fluidized-bed boilers in 1982. They can generate 63.8 million kWh per year at a value of 3.92 million yuan. They turned over 1.46 million yuan in profits. The cost of electricity during the year was from 40 to 59 yuan per 1,000 kWh.

### 3. Power Generation Using Gangue Is Economically Justifiable

First of all, the investments for power generation using gangue are no higher than the investments for conventional electric power. Based on calculations of relevant data, the investments for power generation using gangue are 1,200 yuan per 1,000 kW. Although this amount is 400 yuan per 1,000 kW higher than high voltage generators, it is still economically justifiable in terms of the overall benefits. This is due to the fact that construction of a power station with these generators also requires building a coal mine and a railway for shipping the coal. If these two additional expenses are added to the construction costs, then the total investment is higher than for a gangue power station.

Second, coal consumption is high but the cost is not. A gangue power station consumes about 800 grams of coal per kWh. Although this is 350 grams higher than coal consumption in a conventional high voltage generator, it is burning gangue. The utilization of this waste material means that the cost per kWh is not high.

Third, ash and slag can be used to increase cement production. Construction of a gangue power station at a coal mine allows self-supply of electricity. This not only makes more electricity and coal available for urban industries, but the comprehensive utilization of ash and slag also can be used as a cement mixing material for producing cement. According to calculations, each

1 million kW gangue power station generates 8 million tons of ash and slag per year that can, after processing, be used for production of 20 million tons of cement. At the same time, it can also reduce the amount of land covered with ash and slag and pollution of the environment.

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CSO: 4013/157

## NANTONG RELIES ON TECHNOLOGY TO BOOST COAL PRODUCTION

Chengdu SICHUAN RIBAO in Chinese 27 Apr 84 p 2

[Article: "The Nantong Mining Services Bureau Relies on Technical Progress To Develop Coal Production"]

[Excerpt] The Nantong Mining Services Bureau has focused on bringing the initiative of mine-operated scientific research departments and production units into full play. It has stressed production realities in mining regions and has broadly developed activities and achieved gratifying successes in scientific research, technical innovation, and popularization of new technologies. Some 544 scientific and technical achievements have been made since 1980. One of them received a 3d-place national invention award and a 1st-place award for scientific and technical progress in coal. Five achievements received 2d-place provincial awards for scientific and technological progress. Sixteen achievements received 3d-place awards and 87 achievements received 4th-place awards. The economic benefits from technical innovations alone totalled 5.57 million yuan. The highest historical records in 22 indicators were achieved last year in raw coal and dressed coal and the deficit was reduced by 3.45 million yuan. Coal production plans have been surpassed every month this year.

This bureau organized a mine-operated scientific research institute back in 1978. It organized and managed scientific and technical activities for the entire bureau and allowed S&T work to serve production directly in the mining region. The Nantong mining region is a high methane pit, and there are serious problems with coal and gas. The bureau cooperated with the Chongqing Coal Research Institute to eliminate these threats to safety and successfully studied new "jetting" technologies for preventing coal and gas eruptions that are at advanced domestic levels. These new technologies were not limited to the research and experimentation stage, but also allowed the safe extraction of more than 700,000 tons of raw coal from the No 4 coal seam when there was serious danger. Moreover, they filled a national gap in the prevention of gas in self-injection coal seams and were well-received at home and abroad. The sulfur content of the raw coal in the mining region is as high as 35.6 percent. In the past, after being washed and sorted, it was dumped and wasted in the sulfur and iron tailings pit. To recover this valuable resource, the bureau worked jointly with the Chinese



Mining Academy to develop the first new technique in the nation for refining, selecting, and successfully recovering sulfur and iron ore from washed coal tailings. This successful research increased the profits of the bureau by 560,000 yuan last year along and provided experience for development of comprehensive utilization in high-sulfur coal regions. Emphasis on scientific research was combined with substantial popularization and utilization of new technologies and techniques. This permitted S&T achievements to quickly become forces of production. Production has been effectively promoted in the past few years by the popularization and utilization of 32 new technologies promulgated by the Ministry of Coal Industry. After the No 3 pit at the Nantong Mine began using new technologies for columnless extraction in 1978, tunnel excavation was reduced by 5,176 meters up to the end of 1983 and an additional 44,887 tons of coal was recovered from the columns. This new technique is now being used throughout the mining region. The bureau reduced tunnel excavation by 1,633 meters and recovered an additional 23,000 tons of coal in 1983 alone. Machine and equipment parts in the mining region wear out fairly quickly, so they began using new technologies for metallic thermal spray coating to reduce replacement and repairs due to abrasion. The three axles of the 2.5-meter winch at the Nantong No 2 pit urgently required overhauling because of severe abrasion. Repairs would have taken more than 7 days had they continued to use electroplating, and this would affect production. They adopted new thermal spray coating techniques and solved the problem in a single day. Last year, the mining region used thermal spray coating for 723 parts of more than 30 types. This saved 120,000 yuan and conserved 60 tons of steel.

The vigorous development of activities related to scientific research and technical innovation has led to effective changes in all aspects in the Nantong mining region. Tunnel excavation progressed by just 50 meters per month at the No 6503 extraction zone in the No 3 pit at Nantong because of frequent gas eruptions. Monthly progress increased to 120 meters and work efficiency doubled after new technical measures for deep-hole flexible blasting were adopted. The use of oilless lubrication in 22 blowers saved more than 10 tons of lubricating oil and 400,000 KWH of electricity in 1 year.

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CSO: 4013/169

## COAL

### NEW EQUIPMENT BOOSTS OUTPUT AT LU'AN MINES

OW191156 Beijing XINHUA in English 0722 GMT 19 May 84

[Text] Beijing, 19 May (XINHUA)--Coal mining equipment for cutting seams 3.5 to 4.5 meters thick has been manufactured for the first time in China, according to the Coal Ministry.

Experimental use of the fully mechanized equipment at the Wangzhuang coal mine in Lu'an, Shanxi Province over the past 5 months has resulted in production of 70,000 to 100,000 tons of coal a month, much higher than the previous monthly output.

The machinery is technically up to the level of the late 1970's in developed countries.

The ministry has decided to put the equipment into serial production.

Thirty percent of China's exploitable coal resources is in thick seams. At present, these are cut layer by layer, each requiring a gallery and separate workface preparation. The new equipment will greatly raise efficiency.

CSO: 4013/182

## COAL

### NEIGHBORING PROVINCES INVEST IN HENAN COAL DEVELOPMENT

HK020317 Zhengzhou Henan Provincial Service in Mandarin 1230 GMT 1 Jun 84

[Text] According to JINGJI CANKAO [Economic Reference], Henan will cooperate with Jiangsu, Zhejiang, Hubei, and Guangdong provinces in exploiting coal resources. Jiangsu, Zhejiang, Hubei, and Guangdong will invest 300 million yuan in setting up local coal mines in Henan. In the 25 years beginning 1986, Henan will supply 3 million tons of coal to these provinces each year, with prices determined according to quality and a 25 percent production subsidy added.

The responsible persons of departments concerned in Henan say that this investment will be used in building local county, commune, and brigade coal mines. The provincial coal department has organized personnel to carry out investigation of resources and submit plans. They are preparing to build 63 small coal mines in various counties including Gongxian, Linru, and Yanshi. Work has already started on 30 shafts.

To ensure prompt coal deliveries to fraternal provinces, the province will build a local railroad from Zhoukou to Fuyang in Anhui Province. It is expected to be completed in 1986.

CSO: 4013/182

## COAL

### HENAN, JIANGSU LAUNCH JOINT DEVELOPMENT OF YONGCHENG COAL

Beijing RENMIN RIBAO in Chinese 18 Mar 84 p 1

[Report by Yang Yinglan [2799 5391 5695]: Henan Provides Resources, Jiangsu Provides Funds For Joint Exploitation of Yongcheng Coal Field"]

[Text] With each of the two provinces displaying its own superiority, Henan and Jiangsu are jointly exploiting the Yongcheng coal field and the construction of the first pair of mines there will begin soon. A leading comrade of the central authorities has pointed out that this is an excellent thing worthy of being vigorously popularized.

The Yongcheng coal field is located in Yongcheng County in eastern Henan, adjacent to Jiangsu. In the mining area, more than 500 square kilometers contain coal, with proven deposits of over 2 billion tons, the greater part of which is low-ash, low-sulfur high-grade smokeless coal. In 1978, Henan began to build the Xinzhuang Mine in this mining area, but because of insufficient funds had to stop construction.

In line with the principle of mutual aid and mutual benefit, Henan and Jiangsu signed an economic and technical agreement under which Henan would supply the coal resources and Jiangsu the construction funds for jointly exploiting the Yongcheng coal field. The two sides selected and dispatched personnel to set up the "Yongcheng Coal Industry Joint Company," which is responsible for the work of exploiting and building the entire mining area. After the mines go into operation, they will be turned over to Henan, which will have overall responsibility for their production, management, and administration. In accordance with the actual annual output, the coal products will be distributed in a 70-30 ratio, 70 percent to Henan and 30 percent to Jiangsu. The coal distribution time limit is calculated from the time each mine goes into operation and runs for 50 years in succession. After the distribution period ends, the coal will still be supplied according to the original ratio.

The first-stage construction project in the mining area will be to resume the building of the Xinzhuang Mine, and the construction plan for this project has already been approved by the State Planning Commission. The designed capacity is an annual output of 600,000 tons of raw coal, and it is planned to finish the construction of this mine within 4 or 5 years.

According to a briefing given by a responsible person of the coalfield construction preparatory office, an investment of about 1 billion yuan is needed to build the coal area. Jiangsu has adopted the method of having the province manage and the cities concerned make the investment in order to raise funds. Suzhou City will invest in the Xinzhuang Mine, on which work is about to begin. To support Suzhou's raising of funds during the Xinzhuang Mine's construction period, Henan will provide 200,000 tons of economic coal every year.

The joint exploitation of the coal field by Henan and Jiangsu benefits both the two provinces and the state. After the joint exploitation of the Yongcheng coal field begins, the localities will be able to develop the chemical fertilizer, building materials, light and textile industries, and the foodstuff and feed-processing industries. The comprehensive development of agriculture and other industries will be promoted. Thus, eastern Henan will be changed. In Jiangsu Province, the prospective coal deposits are insufficient and energy supply is comparatively tight.

In the future, high-grade smokeless industrial coal will be distributed to Jiangsu every year, and this will be favorable for industrial development. The exploitation and shipment to outside points of the coal in the Yongcheng Coalfield can relax the tight situation in the communications and transportation of Shandong coal to the south.

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CSO: 4013/158



## COAL

### EXAMPLE SET BY HENAN AND JIANGSU HELD UP FOR OTHER REGIONS

Beijing RENMIN RIBAO in Chinese 18 Mar 84 p 1

[Commentary: "A New Way To Exploit Energy Resources"]

[Text] How to display local superiorities, exploit and utilize the energy resources of various places, and promote the four modernizations constitute an extremely important question at present.

Most of China's coal resources are concentrated in various provinces and autonomous regions in the interior, where the economic base is comparatively weak, financial resources are limited, technical conditions are poor. There is a definite restriction on their ability to rely on themselves to accelerate the building of energy resources. And China's industrially developed areas are mostly distributed in the coastal belt. In these provinces and cities, the economic base is fairly good and the local financial resources and technical conditions are fairly superior, but the energy resources are fairly tight or in short supply. Currently, the state is trying hard to raise funds in order to step up the pace of the construction of key coal, electric power, and petroleum projects. However, the state's financial resources are limited, and there are many things it needs to do. To just wait until the state's key projects are completed and they begin to send coal and electric power to areas where energy resources are tight will not resolve urgent needs. That the two provinces of Henan and Jiangsu have each displayed its own superiorities in jointly exploiting the Yongcheng Coalfield provides us with a good experience. Their experience shows that by displaying local superiorities, taking the path of joint exploitation, having areas with abundant natural resources provide natural resources and the necessary manpower and materials while the economically developed areas provide funds and technical forces--this way of making up each other's deficiencies and giving mutual support--can greatly accelerate the rate of development and of the energy industry.

Comrade Hu Yaobang recently pointed out: There are two aspects in the policy of opening to the outside world: one aspect is to open the entire country to the outside world and to the international community; the other aspect is to open the backward areas to the advanced areas. The joint action

by Henan and Jiangsu is one form. The natural resources, manpower, financial resources, and technologies of the various areas are different, so the forms of joint action will vary.

The key is for the two sides to truly put into practice the policy of opening to the outside world, and not to impose steep conditions that the other side would find difficult to accept. By giving play to the initiative of the center and the localities, and by tapping the potential of the energy resources of the various localities, it may be affirmed that the pace of development of our country's energy industry will be accelerated.

9727

CSO: 4013/158

## COAL

### APPLICATION OF SYSTEMS ENGINEERING IN COAL MINING REVIEWED

Beijing MEITAN KEXUE JISHU /Coal Science and Technology/ in Chinese No 12, Dec 83 pp 5-7

/Article: "A New Starting Point for Applying Scientific Management in Coal Mines"/

/Text/ Early this year, a "Leading Group for the Application of Scientific Management Methods" was established by the Ministry of Coal Industry, with Ye Qing /0673 7230/, the vice minister, as the group leader, Chen Bingqiang /7115 3521 1730/ Shen Jiliang /3476 1323 5328/, and Wu Feng /0702 1496/ as deputy group leaders, together with members from relevant departments, bureaus, and planning institutes. It is a strategic task related to the overall situation, to organize the study of the application of scientific management methods in coal mine production and construction. There is also an urgent demand to have the coal industry take a new path, open up new prospects.

Systems engineering is a comprehensive management engineering method used to determine the best design, control, and management system. It is the product of a combination of a systematic viewpoint, information theory, a control base, modern mathematical methods, and computer technology. Coal mine production is a complex, dynamic system involving many subsystems. Not only is it affected by a great number of factors, it also possesses a random quality. The use of systems engineering to study and deal with problems of coal mine construction and production and technical management can accelerate mine construction and enhance the technical and economic return. Developing the application of systems engineering to coal mine exploitation is a demand of better coal mine extraction design and planning and a demand of stronger coal mine production management. At the same time, it makes it easier to absorb advanced foreign designs and technology, promotes joint planning, and accelerates the modernization of coal mine production and construction. Since the 1950's the use abroad of operations research and systems, engineering theory to study and deal with problems in production, research, and management has grown rapidly. This advanced scientific management method has attracted extreme interest, especially after the U.S. landed Apollo on the moon. Its development can be roughly divided into three stages: the embryonic stage (before 1956), the development

stage (1957-1964) and the mature stage (1965-1980). The path of development in every country has been different: In the U.S., it developed on the basis of operations research. In Japan, after the theory of systems engineering was imported from the U.S., it developed through quality control management. In the USSR, it developed on the basis of control theory. Today, the application of systems engineering to coal mining is developing rather rapidly abroad. It has been used in selecting options for exploitation, optimizing main parameters, and in computer simulations of production systems and production conditions. Not only does it include technical decision making, production commands, management organization, and automatic monitoring in working mines, it also includes the optimization of design, the technical decision making, and the primary parameters of newly constructed mines. In all, the scope and substance of the application of systems engineering and electronic computers in coal mine production and construction abroad is expanding continuously.

The study of systems engineering applications by China's coal sector was slow to begin--not starting until the late 1970's. In 1980, a short training course, "Systems Engineering and Operations Research" was held by the graduate department of the China Mining Industry Institute at the behest of the Ministry of Coal Industry. Some technical personnel also attended short courses on systems engineering held outside the departments. This laid the groundwork--talent-wise and theoretically--for applying systems engineering to coal mining. In recent years, more electronic computers have been installed in research centers, design institutes, colleges and universities, and production organs to provide the necessary material means for advancing work in this area. The leading cadres of the Ministry of Coal Industry now pay great attention to the application of systems engineering in coal production and construction. In 1982, Comrade Hua Luogeng, the chief consultant of the General Scientific and Technological Consulting Company of the China Scientific and Technical Association, invited more than 20 S&T personnel from seven societies representing optimization planning, coal electrical machinery, railways, navigation, energy resources, etc., to form an "Investigation and Demonstration Group of Experts of the China Scientific and Technical Association," headed by Comrade Hua himself. An exploitation program for Liang Fui was demonstrated with excellent results.

In recent years, research on the application of systems engineering in coal mine production and construction has been developing continuously. It has been integrated more and more with production practice, and the range of personnel taking part in the research is growing. Research on the application of system engineering in coal mines is developing and increasing in scope. In September 1983, a symposium on the special topic of "The Application of Systems Engineering in Coal Mining" was held jointly by the Coal Extraction Committee of the China Coal Society and the Jiangsu Coal Society. The papers exchanged at the symposium can be roughly divided into the following:

1. Those describing and assessing the nature of the coal seams using geological and statistical methods that treat the seams as regional random variables. Survey data is used to work up a deposit model (a mathematical model that describes mineral variations), the appropriate program is drawn up, and a computer is used to find the solution. The use of this method permits the computer to draw the contour lines of the coal seam, compute the reserves of the deposit, and provide output on changes in the quality of the coal. In addition, the limits of a strip mine and the sequence of mining may also be optimized.

2. Those referring to the optimum coal extraction design, technically feasible options--technical and technological models--and the desired parameters may be obtained through technical demonstration. The functional relationship between variations in the parameters and the desired goal should be studied to produce an economical and mathematical model. A corresponding computer model may be designed to obtain the best option and parameters for the mines. By using this method, it is possible to obtain a great number of comparisons and choices for an overall plan and program design. It can also reveal the influence of the variation of the parameters on the desired goal. This method has been used to find the optimum length of the working area and the optimum height of the working level. Research on the optimization the draft arrangement and the parameters of the working area has been studied, thus providing the basis for making correct design decisions.

3. Those referring to the optimization of engineering planning and construction arrangement. According to the progress or the sequence of the construction and the mutual relationship between them, the unified planning method (network analysis) has been used to determine the progress of construction and the main conflicts in construction arrangements. The optimization of construction intervals and resource planning may be planned. This method has been used for preparing the working area for exploitation, deepening a new level, and determining the arrangement for constructing a mine. The shortening of construction time, labor savings, and engineering cost savings may be obtained by using this method.

4. Those referring to the simulation of the mine production system. In order to counter random mine production, computer simulation methods are used to provide the kinetic simulation or modeling for the production conditions of a mine and its subsystems. First, the logical and mathematical relationship between production procedures and key elements should be determined, then the simulation principle can be decided upon, and a simulation model established. The mining procedure and the influence of the variation of the parameters on the system may be investigated by computer. The information needed to make decisions and the information needed for future management may be obtained. This method has been utilized for research, on the simulation of the



production system of the stopes, the determination of the volume of the shaftbottom bunkers, and the simulation of the production and transportation systems of the mine. The weak links in the system are then discovered and analyzed, and the type and the number of the equipment are rationally matched, thereby allowing optimum control of the production procedure. In addition, this modeling method may be used to predict system development.

Besides, the comprehensive evaluation for a multi-purpose program design can be carried out by using the method of value engineering. Rational operation for coal cars at the shaftbottom can be researched by the theory of random service system. Production at the working face can be researched by using the theory of system reliability. The relationship between parameters for coal mining may be found by the method of mathematical statistics. In all, it relates to nearly all aspects of coal mine design, coal mine construction, and production. Therefore, systems engineering is the core of scientific management for coal mines and its application in the mines has very broad prospects.

At present, in order to further develop research on the application of systems engineering, the solution of the following problems should be stressed:

First, it is of the utmost importance in the application of systems engineering to find high quality and reliable input. Strictly correct basic data is needed, especially when systems engineering is used for scientifically managing the engineering techniques. Today, the existing predicament in coal mine engineering is that the basic data is not extensive enough, it is inexact, and not easy to gather. It further stresses the existing contradiction between correct decision making from incomplete data. Data collection and methods of observation should be improved gradually. Necessary instruments should be designed and manufactured. Statistical systems and methods should be improved. A monitoring system for coal mine production and construction should be established gradually and in a planned manner. It would provide the output needed for directing coal production quickly and correctly, and would also serve for analyzing, studying, making scientific predictions, and managing.

Second, systems engineering is theoretical engineering. Studying the application of systems engineering in coal mining can only provide certain principles for optimizing plans and technical program designs, and provide certain ideas for management. It is men who make the actual decision. More people would be involved in carrying out the decision-making process. Therefore, it is vitally necessary to spread the knowledge of coal mine systems engineering among relevant personnel and to train technical and managing staffs. In addition, manpower from different regions should be organized and planned as a whole, and mutual cooperation and coordination should be strengthened. The research results should be interchanged and promptly appraised thus enhancing the research level of the whole coal engineering and management profession.

Changing the choice from several technical program designs to the optimum design from multiple options and multiple purposes; changing the qualitative analysis of the technical program design to the quantitative solution of qualitative problems; changing the decisions obtained from ideal and roughly determined conditions to the consideration of the influence of complicated, changeable random factors; changing the management of production depending on individual experience to scientific management and optimum control; and changing the analyses depending on manual computations to analyses by full use of the computer. All this leads to the conversions that should be reached through research of the application of systems engineering in coal mine production and construction. Reviewing the development of the means of computation shows that it took only a few short years to make the transition from manual calculators to electronic computers, which was unforeseen by people then. Today as we face the vast application of computers in scientific management, it would heighten our confidence to review the past.

12631

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## COAL

### OBJECTIVES OF COAL MINE MODERNIZATION IN 1980's EXAMINED

Beijing SHIJIE MEITAN JISHU [WORLD COAL TECHNOLOGY] in Chinese No 7, Jul 83 pp 5-9

[Article by Advanced Engineer Geng Zhaorui [5105 0340 3843], Chief Engineer of Technical Development Department, Ministry of Coal Industry: "Prospects for Developing Mechanization of China's Coal Industry in the 1980's"]

[Text] The Grand objective of China's four modernization is to quadruple GNP by the end of the century. Coal is our main energy source and is also an important industrial raw material and a necessity of the people's daily life. The coal industry's task is to increase coal output severalfold in the next 18 years, achieving an output of 1.2 billion tons a year in order to assure the rapid development of the national economy.

In the more than 30 years since the state was founded, China's coal output has gone from something over 30 million tons to more than 600 million tons a year. Mechanization of coal extraction has been begun, reaching a level of 40 percent by 1982, with fully mechanized coal extraction accounting for 20 percent of the total. In recent years coal mine mechanization has proceeded rather rapidly; we have imported some integrated sets of equipment, while the domestic scientific research and production units have made energetic efforts, developing various models of hydraulic supports, coal mining machines, conveyors, belt conveyors, tunneling machines, loaders, electrical equipment, electrical control equipment, and communications and signaling equipment. The machine building plants subordinate to the ministry have created manufacturing capacities for more than 200,000 tons of machine products a year. The centrally controlled mines have already forged a technical contingent which is fully conversant with mechanized equipment; and a group of fully mechanical mining teams with annual output of a million tons or more and mechanized tunneling crews with a monthly rates of advance of a thousand meters or more have emerged. Many mines have been modernized, with rational concentration of production and expanded capabilities of the individual production links. These factors have laid a firm foundation for further progress in the mechanization of China's coal mines.

The 1980's will be a new period of healthy development and overall progress in China's coal industry and a key period in coal mine modernization. Mechanization of coal extraction and tunneling is the essence and nucleus of coal mine modernization. According to the coal industry's latest long-term scientific and technical

plans and mechanization plans, an effort will be made to achieve 50 percent mechanization of coal extraction, tunneling, loading and transport by 1985, raising the level to 70 percent by 1990. Thereafter, in the 1990's we will strive to basically complete the historic mission of converting China's coal mines to integrated mechanization of coal extraction and tunneling.

To achieve this strategic objective, we must adopt a series of technical policies.

I. To progress in the mechanization of coal extraction, we must implement integrated mechanized mining, ordinary mechanical mining, hydraulic mining and explosive mining simultaneously and gradually. We will vigorously develop integrated mechanical mining while focusing on spreading high-grade regular mechanical mining; and mines able to do so will use hydraulic mining and improve explosive mining machinery and equipment. We must make a vigorous effort to provide mechanized mining technology for thin coal seams, extra-thick seams and sloping seams.

II. We must vigorously expand mechanized tunneling, putting simultaneous emphasis on mechanical tunneling and drilling and blasting, with the latter method the primary one in tunneling through rock, while actively promoting the use of some full-face tunneling machines for tunneling through coal or mixed coal and rock. We must focus on providing sets of supporting equipment, improve mechanized work lines, and strive to increase the speed and efficiency of tunneling. We must make a vigorous effort to improve supports, develop collapsible steel tunnel sets and support by rock-bolting and guniting and gradually eliminate the use of timber.

III. Mechanized extraction and tunneling equipment standards should be raised for both new and reconstructed mines. Large and medium-sized mines should give priority to integrated mechanized mining, and coal mine design should use new model coal extraction, tunneling and transport equipment so as to achieve mechanization of cutting and tunneling and concentration of production.

IV. When proceeding with mechanization, existing mines should carry out effective technical modernization of the production links. They should improve development layout, rationally concentrate production, increase the size of the working area, expand continuous transport, and improve electric power supply, ventilation and personnel and materials transport, as well as coal washing and processing facilities at the surface, so that the technical conditions in the mines will be suited to progress in mechanization.

V. The relationship between use of old equipment and its replacement with new equipment should be handled correctly. Existing equipment should be used effectively and all its capabilities and potential thoroughly utilized, while newer-generation advanced, high-productivity mechanized products should be substituted for machinery that has been in use for 10-odd or 20 years. Alternatively, the capabilities of older products should be upgraded by major overhaul or renovation.

VI. Sufficient importance should be accorded to equipment maintenance and management and the rental of extraction, tunneling and transport equipment, and the payment of depreciation fees to the higher levels should be gradually instituted at the mining office level. Major overhauls should be centrally organized, and

the user organizations should conscientiously and effectively perform medium and minor overhaul and running maintenance. The manufacturing plants must assure a supply of spare parts, improve inspection and maintenance quality, increase the equipment in-service rate, extend its service life, and increase utilization rates and capabilities.

VII. Coal-cutting and tunneling equipment research, design and manufacture should be intensified; while relying primarily on domestic production we should actively import advanced foreign technology, expand the selection, and decrease manufacturing costs. We should effectively arrange standardization and series production of equipment and parts, increase their versatility, strengthen testing procedures, conscientiously implement testing standards and the certification testing system, and develop compatible sets of coal-cutting and tunneling equipment and machines suited to China's conditions, so as to meet the needs further mechanization.

VIII. Local coal mines must also strive to mechanize and must use technology suited to their particular conditions. They should start with such basic safety measures as ventilation, drainage and explosion protection, focus on mechanizing coal cutting, tunneling, loading and transport, and gradually raise the quality of their equipment; medium and small-size mainstay mines should develop high-grade ordinary mechanized extraction and unified, mechanized power-equipped tunneling work lines.

IX. Due importance should be accorded to development of knowledgeable personnel and to effective technical training. The relationship between men and equipment in the mechanization process should be handled correctly; advanced equipment must be mastered by personnel with technical knowledge if good results are to be obtained from it. The colleges and technical schools in the industry system must strengthen basic education in coal mine mechanization and effective on-the-job training in the mechanical and electrical fields must be provided for cadres, technical personnel and workers so that they master techniques and information in the use and management of coal-cutting and tunneling equipment. Cadres who are enthusiastic about modernization and familiar with it should direct mechanized production at the office and mine level.

X. A variety of economic policies in such areas as wages and bonuses, quota contracting, partial profit retention and the like should be used in order to encourage enterprises and employees to concern themselves with mechanization and promote its progress. In the mechanization process emphasis must be laid on overall, aggregate technical and economic indicators so as to give the enterprises and workers true security and technical and economic benefits.

China has extensive coal fields, but their geological conditions are complex and variable, so that a wide variety of extraction processes and tunneling and coal-cutting equipment are needed. Without advanced, reliable, versatile equipment mechanization will not be possible. During the 1980's China must achieve great progress and improvement in the quality and capabilities of coal-cutting, tunneling and transport equipment, fill in gaps in the selection, provide full sets of compatible machinery, develop a relatively complete mechanized Chinese-style coal-cutting, tunneling and transport system, and reach or



approach late 1970's or early 1980's advanced world standards in terms of the capabilities and quality of key products.

In the area of compatible sets of mechanized coal-cutting equipment, in addition to consolidating and improving existing integrated and high-grade ordinary mechanized equipment sets for medium-thickness seams, we must speed up the development of the following 12 types of set-compatible equipment:

1. Sets of equipment for full-face extraction of seams 3.5 to 4.5 meters thick.
2. Hydraulic supports and auxiliary equipment for caving of extra-thick seams.
3. Integrated sets of equipment for hydraulic backfilling of extra-thick coal seams.
4. Sets of equipment for longwall hydraulicking of extra-thick seams using hydraulic supports.
5. Integrated sets of mechanized equipment for steeply-sloping high-reach seams.
6. Economical integrated mechanized sets for medium-thickness and relatively thin seams.
7. Integrated sets with strong supports for tight roofs.
8. Integrated mechanized sets for thin seams 0.8 to 1.3 m thick (both sets using coal-cutting machines and sets using coal ploughs).
9. Sets of equipment for high-grade conventional mechanized mining of thin seams (including sets incorporating both coal-cutting machines and coal ploughs).
10. Set of equipment for mechanized shortwall extraction of thin seams with non-rail transport (including continuous miners, self-propelled extensible belt conveyors, and self-propelled shuttle cars).
11. Sets of equipment for mechanized extraction of extremely thin seams (including floor-creeper coal cutters, self-advancing pier columns and the like).
12. Sets of equipment for mechanized extraction under broken roofs (including short, narrow-bodied mining machines, articulated movable bars and the like).

Research and development in electrical and mechanical equipment for coal mining should include:

1. Drum-type miners.

- a. Thick seam mining machines: in addition to the mining machine with a cutting height of 4.5 m and an individual engine power of 300-375 KW now under development, preparations for subsequent development of powerful mining machines with a cutting height of 5 meters and a motor power of 450-500 KW.
- b. Thin-seam machines: In addition to the 100 KW and 150 KW slot-mounted /qiliu 7595 3296/ and creeper mining machines now under development, preparations for near-term development of double-ended arch-section creeper-type mining machines and rope-operated mining machines for extremely thin seams.
- c. Along with consolidation and improvement of existing models for medium-thick seams, preparations for development of versatile 200-KW mining machines with a cutting height of 1 to 3.5 meters.
- d. Development of midget mining machines for conventional extraction under broken roof rock.
- e. Active development of chainless traction and electric traction technology.
- f. Improvement of the capabilities and life of parts and components. Hydraulic pumps and motors must undergo 1,000 hours of full-load testing, and cutting and traction components 600-1,000 hours of full-load testing, in order to achieve a level of 150,000 to 300,000 meters of failure-free cutting in the mine, and 2 to 3 years before a major overhaul. Improvement of the capabilities and reliability of cutter teeth, drums, gears, hydraulic components, high- and low-speed oil seals, and spray systems.

## 2. Coal Ploughs

- a. A focus on thin seams, with accelerated development of the H-26 sliding plough and preparations for development of the TH-30 sliding drag-hook plough, and a high-pressure water-jet plough.
- b. Development of a low-clearance gear box, two-speed electric motors and new plough blades for coal ploughs, as well as path display, terminal control, directed spray and other components and equipment.

## 3. Hydraulic Supports

- a. Shield and chock-shield supports for thick seams with heights up to 4.5 meters.
- b. Caving supports for extra-thick coal seams, self-installing lattice supports, and work face supports for hydraulic backfilling.
- c. Development of light supports and optimized support designs.
- d. Development of large-extension-ratio supports for thin seams.

- e. Development of end supports and designation of versatile standardized series.
- f. High-initial-resistance single hydraulic props and movable beams.
- g. Self-advancing breaker props for high-grade conventional mining.
- h. Development of new support structures and new control systems: auxiliary equipment for supports in steeply-sloping seams, sectional support equipment for thick seams, and telescoping forepoles, as well as multistrand optical fiber light guide [reading guang 0342 for xian 0341] control and modular program control systems
- i. Improved capabilities and life of support components, series production of double telescopic props, development of cold-drawn steel tubing and new protective plated coatings, sets of 320-bar valve groups, pipe runs and components. Fatigue loading tests on the full supports should involve at least 5,000 repetitions.

#### 4. Work Face Transport

- a. Perfecting and improving existing double-chain and single-chain conveyor systems, with a focus on double central-chain conveyor belts and designation of standardized series, as well as perfecting work face transport equipment with a capacity of 600 tons per hour or less and designation of standardized series.
- b. Development of two-speed pole-changing electric motors and other technical approaches in order to solve the difficulties of starting of conveyors and sparking of hydraulic linkages.
- c. Development of 90° angle conveyors, side-dumping conveyors and closed-bottom trough conveyors, followed by preparations for development of heavy work face conveyors with capacities of 800 to 1,000 tons per hour.
- d. Improvement of the antiwear and anticorrosion capabilities and service life of class C round-link chain and connecting links, and development of class D round-link chain and connecting links.
- e. Improvement of the capabilities and life of parts and components, with gear boxes required to undergo at least 1,000 hours of full-load testing; improvement of the wear resistance of conveyor troughs, and development of stronger fastener components for them, increased life of sprockets and scraper paddles; increasing the reliable transport capacity of heavy conveyors (with trough sides 200 mm or more high) to 1-1.5 million tons or more, that of medium conveyors (height of trough sides 190 mm) to 600,000-800,000 tons or more, that of light conveyors (height of trough sides 180 mm) to 300,000-500,000 tons or more), and that of small conveyors (with pressure formed sides) to 200,000-300,000 tons or more.

## 5. Electric Control Equipment

- a. Improvement of existing 1140 volt and 600 volt electrical equipment sets.
- b. Improving the capabilities and life of specialized electric motors for coal mining machines, coal ploughs, tunneling machines and conveyors, and designation of standard series.
- c. Further development of the variables of antiexplosion vacuum switches and group switches whose safety characteristics are susceptible of improvement, and of electrical control equipment for various types of mining and tunneling machinery.
- d. Development of tension-resistant rubber-insulated trailing cable for mining and tunneling machinery.
- e. Development of monitoring and control, diagnostic, and telemetric systems for work face machinery, as well as signal and data collection, transmission, processing, recording and display equipment.
- f. Improved work face communications and signaling equipment, and its connection into mine communications networks.
- g. Feasibility studies of the use of high voltages (30,000-50,000 volts) in down-mine and face area 10,000-volt equipment.
- h. Chemical grouting materials and equipment for roof reinforcement, including the development of cheap, practical cementing materials and filling grouting pumps for mixed materials.
- i. Equipment for backfilling with permanent roadway supports in mining without coal pillars, including support installation and replacement, roadway lining blocks, and pneumatic backfilling equipment, as well as guniting equipment for sealing.

In the area of equipment sets for mechanization of tunneling, the primary concern is to develop new models compatible with existing equipment sets, producing the following seven types of mechanized tunneling lines in order to meet the requirements of different tunnel geological conditions and production processes.

1. Full-face rock tunneling machinery and auxiliary equipment.
2. Part-face tunneling equipment for coal and for mixed coal and rock, and extensible belt conveyors and other auxiliary equipment.
3. Mechanized large-cross-section rock tunneling lines which include hydraulic drill jumbos, side-dumping rock loaders, and scraper loaders.

4. Mechanized rock tunneling lines composed of drilling and bolt-installing units, belt transfer conveyors and sprayer units.
5. Mechanized rock tunneling lines comprising high-efficiency air leg pneumatic drills, scraper-type transfer loaders, bucket loaders, shunting switches, and bolting and guniting equipment.
6. Mechanized coal and mixed coal and rock tunneling lines comprising wet-type electric coal or rock drills, rake-type coal loaders, and transfer belt conveyors.
7. Mechanized rock and coal tunneling lines for small coal mines with a unified power source, comprising electric percussion-type rock or coal drills, small scraper loaders and the like.

The main areas of development in tunneling equipment are as follows.

1. Full-face tunneling machines: in addition to continuing improvement of the 3-m machine which has already passed evaluation, development of a more capable full-face tunneling machine with a 5-meter diameter.
2. Part-face tunneling machines: improvement of existing medium and small cross section tunneling machines for coal or mixed coal and rock, and improvement of the capability and life of their parts and assemblies; experimental production of medium-sized mixed coal and rock tunneling machines with cutter motor power up to 100 kW; later development of a heavy part-face tunneling machine with a cutter power of 160-200 kW.
3. Hydraulic rock drills and hydraulic drill jumbos: development of high-efficiency rotary hydraulic percussion rock drills and 2-5-arm hydraulic jumbos, and designation of standard series.
4. Drill truck-loaders: development of combination drill truck-loaders suited to various cross sections which can take pneumatic or hydraulic drills and are suitable for drilling shot holes, cutting in and drilling bolt holes, as well as functioning as scraper loaders, and designation of standard series.
5. Loading machinery: development and improvement of various side-dumping, scraper-type and rake-type loaders and designation of production series for various tunnel cross sections and loading capacities.
6. Transfer loaders: improvement of scraper and belt conveyors, bucket-type transfer loaders and shunting switches, and improvement of their adaptability and reliability.
7. Tunneling conveyor equipment
  - a. Improvement of continuous transport systems using extensible belt conveyors or scraper conveyors, and development of bunker-type conveyors.



b. Tracked transport systems: improvement of the safety and reliability and battery life of special explosion-proof and hydrogen-suppression battery carts and development of bunker trains.

c. Research on the reliability and cost-effectiveness of wheeled and non-tracked transport vehicles such as shuttle cars and shovel loaders for tunneling.

#### 8. Supports and related equipment

a. New-design collapsible bolts and bolt drilling and installing tools.

b. Wetting and humidifying devices and central feed and mixing system equipment, as well as other types of dust control equipment.

c. Energetic development of collapsible steel supports, and development of channel and flared-section steel and fastenings, as well as equipment for installation, recovery, machining and repair.

#### 9. Ventilation and dust removal equipment

a. Development of explosion-proof exhaust fans and extensible air ducts, and designation of standard series.

b. Development of high-efficiency dust removal devices compatible with tunneling machinery, and designation of standard series.

c. Development of fogging (and toothed-plate fogging) systems for inclusion in tunneling machinery.

#### 10. transport facilities:

##### 1. Belt conveyors

a. Improvement of extensible face-area conveyors and development of both suspended and ground-based types in three series: 650, 800 and 1000.

b. Development of belt conveyors for upward and downward transport in inclined drifts, with suitable arrangements for braking, stopping and reversing, provision of multiple electric-motor drives, overspeed protection and other key technical solutions, and the designation of standard series of parts and components.

c. Development of steel-reinforced belt conveyors, improvement of steel cable belt conveyors, improvement of capabilities and life, and designation of standard series.



d. Improvement of the capabilities and life of belt conveyor parts and assemblies, and the use of strong, fire-proof belts, low-resistance, long-life rollers, and various operating safety devices.

2. Development of clean, explosion-proof internal combustion vehicles for mine use. Abroad, internal combustion vehicles are safer and more economical than battery-power vehicles, and already account for 65-70 percent of the down-mine vehicles in use in France, England and Germany. Explosion-proof internal combustion vehicles independently developed in China are being tested in the Kailuan mine and in the future will be developed into standard series, with improvement of their safety and environmental health characteristics and operating reliability.

3. Single-rail hoists: development of explosion-proof internal combustion drives and steel-cable-operated single-rail hoists, as well as overhead rails, turnouts, hangers and other accessories and auxiliary equipment for use in transport of equipment, materials and personnel in mining and tunneling work areas.

4. Explosion-proof hydraulic winches: development of explosion-proof hydraulic-transmission hoisting winches with drum diameters of 1.2, 1.6 and 2.0 meters for transporting personnel and materials; and remodeling and replacement of down-mine non-explosion-proof winches.

5. Bottom-dumping mine cars: improvement of the reliability and durability of narrow-gauge bottom-dumping mine cars, and designation of standard series.

6. Improvement of the safety, reliability and versatility of personnel transport vehicles and equipment.

The only course open to mines is mechanization. Pursuing the mechanization of mining and tunneling is a fundamental strategic measure for technical modernization of old mines, leading to improved use of potential and increased output, for accelerated construction of new mines, for improving worker safety and working conditions, for improving the look of coal mines, and for developing the coal industry. The 1980's are the key period for the changeover to mechanization in China's coal mines, and we coal miners must make a vigorous effort to contribute even more to this glorious task.

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## OIL AND GAS

### HEAVY INFLUX OF NEW TECHNOLOGY SUPPORTS DEVELOPMENT OF ZHONGYUAN FIELDS

OW181419 Beijing XINHUA Domestic Service in Chinese 0045 GMT 14 May 84

[By Reporter Yang Yingian]

[Text] Zhengzhou, 14 May (XINHUA)--The Zhongyuan oil field has been able to speed up construction, thanks to coordinated efforts at using science and technology to tackle problems and to the adoption of advanced domestic and foreign technologies. In 1983, the oil field's newly discovered oil and natural gas reserves were the highest in the last 10 years. Crude oil output also exceeded 3 million metric tons, a 40-percent increase over 1982.

The Zhongyuan oil field is one of the key projects included in China's energy expansion plan for the next few years. It has rich reserves of crude oil and natural gas and it may become a major natural gas base in eastern China. However, geological conditions are fairly complicated at Zhongyuan, where there are many faults, where some strata have alternate deposits of oil, gas, and water and where some oil deposits are buried in strata deep in the earth. Because of this, a number of scientific and technological problems will have to be solved in order to develop this field.

In 1983, the State Council made a decision to speed up exploration and exploitation of the Zhongyuan oil field. Since then, 51 scientific research units, institutions of higher learning, and plants, mines, and other enterprises have sent nearly 200 specialists, professors, scientists, and technicians from across the country to the field to tackle jointly difficult scientific and technological problems, promote cooperation in science and technology and offer on-the-spot service. The field has signed contracts with them for joint efforts to solve 84 technical problems. Now 13 of the contracts have been fulfilled and 51 others are being fulfilled. In addition, the Ministry of Petroleum Industry has also transferred 228 engineers and technicians to Zhongyuan to render assistance, and more than 1,000 college and secondary technical school graduates have been assigned to work here by the Ministry of Petroleum Industry and Henan Province. Professor Zhang Wenyou of the Chinese Academy of Sciences, and other geological experts, with the cooperation of concerned scientists and technicians, have carried out comprehensive geological research, an appraisal of oil and gas resources, and other research on the field. They have written over 50 valuable papers and reports that offer further proof that the Zhongyuan oil field is endowed with a considerable wealth of oil and gas resources and that it is fully equipped to speed up its development.

The Zhongyuan field has also tried to solve some production problems and promote its technological progress by importing, transplanting and popularizing new technologies and techniques. Last year the oil field completed 188 scientific research and innovation projects. During its "scientific drilling year" activities, the field popularized seven new techniques, including high-pressure injection drilling and scientific slurry. The number of the field's drilling teams whose annual drilling footage reached 10,000 meters increased last year from 20 to 31. The No 32414 Drilling Team, in cooperation with the Dagang oil field and other units, successfully sank a 2,531-meter-deep directional rescue well, thus bringing an uncontrolled blowout under control. Some imported advanced techniques have also shown certain results.

CSO: 4013/180

## OIL AND GAS

### GOOD PROSPECTS FOR FOREIGN PARTICIPATION IN DEVELOPING NANHAI

HK260935 Beijing RENMIN RIBAO in Chinese 24 May 84 p 3

[Report by Xing Fengbing [6717 7685 3521]: "Broad Prospects for Cooperation With Foreign Countries in Opening Up the Nanhai Oil Field"]

[Text] Since oil prospecting work started in China's Nanhai, it has been more and more closely followed by the world's noted companies which can provide offshore services. At present, 28 oil companies in 9 countries have established ties of cooperation with the China National Offshore Oil Corporation, and dozens of foreign specialized companies have formed joint companies with China's relevant departments and enterprises to undertake contracted responsibilities and services in various forms.

Nanhai is beautiful and richly endowed, covering a vast expanse of sea of over 2 million square kilometers. It not only has numerous kinds of aquatic and mineral resources, but is also rich in oil resources. Beginning in the early 1960's, China's oil and geological departments carried out geological general surveys and offshore prospecting in some locales in the Nanhai waters and good oil-bearing and natural gas-bearing wells were drilled in Nanhai's Beibu Gulf and the mouth of the Zhu Jiang. However, because of limits in various aspects, general surveys and prospecting work proceeded relatively slowly.

Beginning from 1979, China signed one agreement after another with foreign companies on geophysical prospecting. In a year or so, over 87,000 kilometers of linear seismic testing was carried out over 300,000 square kilometers of sea area and by means of precision calculation, explanatory data and maps of high quality were obtained. Some 240 prospective oil-bearing structures were discovered. Consequently, an overall assessment of Nanhai's geological situation was made.

At present, general surveys in Nanhai have given way to fulfilling contracts and unfolding offshore prospecting in a comprehensive manner. Since cooperation started, 16 prospecting wells have been drilled in the Beibu Gulf basin and the Yinggehai basin. Ten of the wells have shown oil and natural gas and some are highly productive oil wells or natural gas wells with a daily output of more than 1,000 tons of crude oil or 1.2 million cubic

meters of natural gas. As an average, out of slightly more than one well drilled, one well showed either oil or natural gas. In 4 years' time, an oil field and a natural gas field have been discovered. The rate of success in prospecting is very high.

Cooperating with foreign countries in prospecting and exploring offshore oil has provided a good place and opportunity for learning advanced technology, scientific knowledge, and ways of management and operation from foreign countries. In the past, we were not very clear about technology in other countries and did not have much economic information. Even when we were aware of certain technology and sent people out to learn it, we found it very difficult to learn it well. At present, through cooperation with foreign countries, various kinds of information flow into our country and we can learn, digest, and apply foreign technology with a clear purpose, in a planned way, and according to the needs of our country. In the past, we were accustomed to directing production by means of administrative measures. This old practice no longer works following the opening of our country to the outside world. We are therefore compelled to learn to organize production by economic means and by the method of inviting tenders, we can effectively control market prices, grasp international quotations, and understand the world's new science and technology. Cadres of the Nanhai eastern and western oil petroleum corporations have come to familiarize themselves with what was new to them and are gradually mastering technology which they did not know. With efforts of the past few years, a substantial contingent of technical cadres who have basically grasped a complete set of prospecting technology and methods, including drilling, positioning, well-testing, and diving have been trained.

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## OIL AND GAS

### SICHUAN LAUNCHES EFFORT TO PRODUCE RECORD AMOUNT OF NATURAL GAS

Chengdu SICHUAN RIBAO in Chinese 11 Apr 84 p 1

[Article by Chen Shi [7115 1395] and Li Ge [2621 2047]: "Determined To Double the Output of Natural Gas as Soon as Possible"]

[Text] Determined to double output of natural gas as soon as possible, the Sichuan Petroleum Administrative Bureau has actively adopted measures to accelerate prospecting, to vigorously increase reserves, and to break the record in the "Seventh Five-Year Plan" period.

Since the beginning of 1984, the bureau's CPC committee has organized leading cadres at all levels and the broad masses of staff and workers to discuss the issue of doubling the output of natural gas around the important directive of central leading comrades on speeding up the prospecting and development of Sichuan's natural gas and the call of the provincial CPC committee on focusing efforts on "making the people rich" and "upgrading standards." After repeated discussions, they have liberated their thinking, broadened their horizons and enhanced their confidence. They believe that there are many favorable conditions as well as definitive scientific bases for doubling natural gas output. First, Sichuan is rich in oil and gas resources. Industrial oil and gas veins have already been discovered and drilled in the strata between several hundred meters and several thousand meters deep below the Sichuan Basin. About 60 percent of known oil-bearing strata have not been drilled. Even in the eastern area of Sichuan Province where major oil deposits are located, about two-thirds of the strata have not been drilled. Second, Sichuan Province has an oil contingent consisting of staff and workers who are politically and technically competent and able to handle the most formidable tasks.

To fulfill Sichuan's fighting goal of doubling natural gas output, the Sichuan petroleum bureau has decided to vigorously strengthen prospecting work and try in every possible way to find more natural gas deposits. First, it is necessary to resolutely implement the principle of boosting gas with gas, concentrate more funds for use in oil and gas prospecting work and guarantee that more deposits can be discovered. Second, it is necessary to focus on making breakthroughs in key areas. Efforts should be concentrated on the prospecting of 13 new gas fields and oil-bearing strata in the eastern area of the province. At the same time, efforts should be made to do a good job



in re-prospecting old gas fields in the southern and southwestern areas of the province. This is to stabilize existing output and to make new discoveries and expand prospecting results. Third, it is necessary to strengthen the comprehensive geological and seismological studies and well logging work. It is necessary to ensure that the locations of wells and strata are selected precisely, more high-yield strata are discovered, more high-yield wells are sunk and the rate of success in drilling increased. Fourth, it is necessary to switch to relying on technical progress, tapping potential, and carrying out transformation. It is not only necessary to concentrate on using and perfecting the new technologies and production skills which have proved effective through practice, it is also necessary to continuously create and import new technologies and equipment. Fifth, it is necessary to do a good job in the preparation and preliminary work to double the natural gas output, increase the prospecting work load for this year, and to strive to discover more geological deposits this year.

At present, the production situation of the Sichuan petroleum bureau is promising. Its natural gas production is one of continuous growth. In the first quarter of this year, its major targets, including seismological prospecting, drilling footage, workload, total industrial output value, and natural gas and crude oil output, overfulfilled their production plans for the first quarter across the board. Among them, total industrial output value, drilling footage, crude oil output and crude oil processing volume set records for the corresponding period of the last 5 years.

12302

CSO: 4013/152

## OIL AND GAS

### GEOLOGICAL STRUCTURE OF EAST CHINA SEA AND ITS OIL- AND GAS-BEARING PROPERTIES

Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese No 4,  
Dec 83 pp 365-370

[Article by Liu Guangting [0491 0342 7844] of the Petroleum Geology and  
Marine Geology Bureau of the Ministry of Geology and Mineral Resources]

[Text] The East China Sea is one of China's enormous Cenozoic sedimentary  
basins. It has a large area, deep sediments and multiple structures as well  
as excellent oil- and gas-bearing prospects.

#### I.

The East China Sea is located to the east of China's Zhejiang and Fujian  
Provinces. It extends north of Madao Island and south of a line from the  
mouth of the Chang Jiang to Cheju Island and is bordered by the Yellow Sea.  
It is separated from the South China Sea by a line linking South Aodao and  
Ejianbi in Taiwan. The eastern boundary borders on the Pacific Ocean and  
is segmented by the Ryukyu Archipelago that runs 1,200 kilometers from  
Japan's Kyushu Island to China's Taiwan. The sea covers an area of 750,000  
square kilometers.

The terrain on the bottom of the East China Sea was formed by new tectonic  
activity during the later part of the Quarternary era and received large  
amounts of silt and organic matter fill carried by the Chang Jiang, Qiantang  
Jiang, Ou Jiang and Min Jiang rivers flowing from the Chinese continent.

Based on exploration and sampling, the profile extending from the Chinese  
continent past the Ryukyu Islands to the Pacific Ocean shows the components  
to be the East China Sea Continental Shelf (the Diaoyu Island Arc), the  
Okinawa Trench, the Ryukyu Volcanic Arc, the Ryukyu Trench and the Philippine  
Sea Basin (Figure 1).

#### 1. The East China Sea Continental Shelf

This is a natural extension of the Chinese continent onto the sea floor.  
It is wider in the northeast (its widest part, 550 kilometers, is southeast  
of the mouth of the Chang Jiang) and narrower in the southwest. The terrain  
is flat and broad with a slight incline to the east at an average slope of  
0° 1' 17". The area covers about 540,000 square kilometers.

The East China Sea Continental Shelf may be divided into interior and exterior zones. The water depth ranges from 50 to 60 meters in the interior zone and the sediments are coarse-grained. The Danshan Archipelago, the Yushan Archipelago, the North and South Jishan Archipelagoes and others are scattered through the area. The exterior zone has submarine terraces with water depths of 75, 90, 110, 150 and 170 meters, respectively. The sediments are fine-grained. There are obvious transitions in the terrain of the submarine terraces that indicate ancient shorelines in the areas with water depths from 50-60 and 90-100 meters. Submarine deltas developed off the mouths of the Chang Jiang and Qiantang Jiang, and there are two submarine river channels extending in an ENE direction. The special characteristics of the submarine deltas are: moving in a south-to-north direction, different deltas are in a stacked arrangement, and from east to west, there are different distributions of advancing and retreating new and old deltas.

There is an obvious increase in the slope at the eastern rim of the continental shelf (the average slope is 0.019) accompanied by increasing water depths. In this area, there are submarine island arcs and the so-called Diaoyu [fishhook] Island Arc. They are wide in the north (40-60 km) and narrow in the south (20 km). There are strongly-developed rifts, folds and volcanic activity as well as great elevational differences from the sea floor to the mountains. The main body of the island arc is Pleistocene to Holocene alkaline basalt and there is a 2-meter-thick emerged coral reef.

## 2. The Okinawa Trench

This runs parallel to the Ryukyu Island Arc and extends in a NE to SW direction. It has a "U" shaped profile and the slope of the flanks exceeds 10 degrees. The flanks are controlled by rifts and show intense new tectonic activity. The western flank surface has Pliocene and Quaternary turbidity current accumulations that are 1.2 kilometers thick. The oceanic trench is deep in the south and shallow in the north. The greatest depth in the south is over 2,700 meters and it becomes shallower going to the north, where it is about 800-900 meters deep. There are enormous elevational differences from the sea floor to the mountains in the bottom of the trough.

According to gravity calculations, the mantle is 28-30 kilometers thick here. There is a high thermal convection value with an average as great as  $2.97 \pm 1.51$  HFU, higher than the thermal convection value in the Sea of Japan and the Sea of Okhotsk. This shows that the Okinawa Trench has undergone continuous extension.

## 3. The Ryukyu Archipelago

This is a volcanic island arc and the rock is high-aluminum content basalt. There are relatively thin island shelves (4 to 35 km) on both flanks. The terrain is complex, with crisscrossed beaches and dense lithic reefs.

Volcanic activity has been continuous here from the Cenozoic up to today. There is obvious earthquake activity with associated crystal movements and

new structural movements. There are left-turning level bedded plane faults running crosswise in a NW direction, such as the northeastern part of the Gonggu depression. There are also earthquakes associated with the Tokara Strait.

#### 4. The Ryukyu Trench

There are turbidity sediment strata 600 meters thick at the southern tip near Taiwan and the depth of the trench is less than 6,000 meters. The trench increases in depth going toward the northeast and exceeds 6,000 meters near Okinawa. The accumulated strata become thinner or disappear.

The thermal convection value of the entire Ryukyu Trench is quite low, which conforms to the normal laws of oceanic trenches.

This shows that the East China Sea has a trench-arc-trough system. If Fujian and Zhejiang are visualized as an ancient island arc, then the East China Sea Continental Shelf should be an inter-arc basin between the island arc and the Ryukyu arc. Their evolutionary history is summarized in Figure 2. There were a series of folded mountain systems from the early Tertiary to the early part of the Miocene running from the southwest part of Japan to Taiwan in China. Their leading edge was a shallow subsidence zone. The subduction of the Pacific plate during the mid-Miocene formed a series of parallel trenches on the ocean side of the Ryukyu Arc. Faults also occurred at the same time along the western limb of this mountain system. The Okinawa Trench was formed by spreading. The sea trough continued spreading, causing the remnants of the Ryukyu Arc to be uplifted and begin forming a new island arc. There were arcuate faults with associated volcanic activity during the formational period of this new arc. The modern Diaoyu Island Arc is a remnant of this. This is also called the central uplifted-folded zone. The rotation of the plate as it moved caused the Ryukyu Arc to float toward the Philippine Sea. As a result, the Okinawa Trench was formed between the Diaoyu Island Arc and the Ryukyu Arc. Moreover, the trench has undergone continuous spreading since the later part of the Miocene. If the Okinawa Trench spread evenly, then the average rate of spreading of the 120-kilometer wide trench over a 10-million-year period was about 1.2 cm per year.

It should be pointed out that Taiwan Island at the southern end of the East China Sea is a region of conjunction between the Philippine and Ryukyu Arcs, and has some peculiarities in comparison with normal island arcs. 1) It projects inward, not outward, from the Pacific Ocean. 2) The outer island shelf on the eastern coast is very narrow and there is no trench on the western coast. Thus, we normally would consider Taiwan to be a coastal mountain range on the Asian continent and not a plate which came from elsewhere and was inlaid onto the Asian continent. However, the frequent earthquake activity on Taiwan not only shows the special characteristics of the tectonic movements and fault distribution, but also provides evidence of a Benioff zone. The distribution of the epicenters of the large number of earthquakes shows that the earthquakes on Taiwan are primarily of shallow origin and that they occur only within a narrow belt parallel to the eastern

coast. This is especially true in that Taiwan's Benioff zone slopes toward the Pacific Ocean, showing that there is a reverse subduction zone which is different from most. Of course, Taiwan also has quite a few geological and geophysical dissimilarities, but there must be a rational explanation of the reverse subduction zone: the Philippine Plate was subducted in the region of the Okinawa Trench but collided with the Eurasian plate on the eastern side of Taiwan (from the Miocene to Holocene). This resulted in a great degree of basement subsidence in the southwestern part of Taiwan. In combination with the western movement of the central mountain range facies, this created a zone of reverse subduction (Ludovich, 1970 and Murphy, 1973).

## II.

Since 1974, the Marine Geological Survey Bureau of the Ministry of Geology has carried out a preliminary comprehensive marine geology survey as well as general surveys and petroleum surveys of some areas of the East China Sea. These included depth measurements, magnetism, gravity and seismic reflection. The Aerial Geophysical Exploration Brigade of the Ministry of Geology also has carried out aerial magnetic surveys.

Seismic reflection profiles shows clearly that the East China Sea, especially the western area, has sedimentary strata more than 8,000 to 10,000 meters thick. Three strata groups with unconformity contact relationships can be demarcated. The first strata group is level and broadly distributed. The earthwave propagation layer velocity was 2,350 to 3,000 meters per second and is of Quarternary and Pliocene origin (Q + N2). The second strata group has folding deformation and occurs in a wedged-shaped distribution within the depressions. The layer velocity is 3,050 to 4,200 meters per second and it is of Miocene origin (N1). The third strata group also is deformed by folding. The layer velocity is 4,000 to 5,000 meters per second and it is inferred to be of Tertiary or even earlier origin (E or AnE).

Based on the distribution of the second strata system (the Miocene), we can carry out a discussion of the structural zones of the East China Sea. The structure of the East China Sea spreads out from the NNE and NE, forming an arc-like structure that is convex to the east. Moreover, there is an alternating sequence of depressions and rises, and the rises alternate with the depressions of the secondary system. It is obvious that this arc-shaped belt structure is closely related to the formation and development of the oceanic trenches and island arcs on the rim of the Eurasian continent. At the same time, they also controlled the development of sediments and structures. In this way, the structural components of the East China Sea may be classified into:

1. The Zhejiang-Fujian Uplift Zone
2. The Ryukyu Uplifted-Folded Zone



3. The East China Sea Basin Zone--the area can be as great as 460,000 square kilometers and the secondary structural components can be demarcated.

1) The Diaoyu Uplifted-Folded Zone--the geographical position of this zone is equivalent to that of the Diaoyu Island Arc and it covers about 56,000 square kilometers. The Miocene system is absent or has been eroded here.

2) The Okinawa Subsidence Zone--the geographical position of this zone is similar to that of the Okinawa Trench and it covers an area of about 146,000 square kilometers. There are traces of many types of tectonic activity here.

3) The East China Sea Subsidence Zone--this zone is located on the East China Sea Continental Shelf and covers an area of 260,000 square kilometers. It is a region of relative stability and has a secondary basin (sedimentation center) and structural zone.

a. The East Zhejiang Basin--the basin is located to the east of Zhejiang Province and has deposits of enormous thickness. It contains the Dandong structural zone (east of the Danshan Archipelago) and the East Zhejiang Changheng (in the eastern part of the basin). The latter is near the Diaoyu Islands uplifted-folded zone. It is a long structural belt that is 400 kilometers long and 10-15 kilometers wide.

b. The Taipei Basin--this basin is to the north of Taiwan and contains the Wendong structural zone (the eastern part of Wenzhou), the Taipei structural zone (to the north of Taiwan) and the Diaobei structural zone (the northern part of the Diaoyu Islands) going from west to east.

c. The Taixi Basin--this basin is located on the western side of Taiwan Province in the Taiwan Straits and contains the Pengbei (Penghu) structural zone.

It should be pointed out that this is only a preliminary demarcation of the structural components of the East China Sea. Other interpretations could be possible by merely considering two aspects in the same way.

First, if we emphasize the significance of the basins and combine the uplifting of the East China Sea Depression Zone, the Okinawa Depression Zone and the Diaoyu Islands Uplifted-Folded Zone with the Zhejiang-Fujian Uplifted Region and the Ryukyu Uplifted-Folded Region, then it seems entirely possible, at least in principle, to change the above demarcation of two uplifts and one basin into three uplifts and two depressions (subsidence zones). If we eliminate the demarcation of the first stage structures, the locations of the East Zhejiang, Northern Taiwan and Western Taiwan depressions (basins) are made even more prominent.

Second, if we consider the existence and significance of faulting in a NW or WNW direction (if the faults occur between the Okinawa Islands and Gonggu [Miyako] Island), then we can discover differences from south to north, regardless of whether we use the fault boundaries of this group to demarcate



the Ryukyu Trench, the Ryukyu Archipelago, the Okinawa Trench or even the Fishhook Archipelago and the East China Sea continental shelf. There are different sedimentation centers in the basins of the East China Sea continental shelf from south to north and the tectonic structures are also completely different.

Thus, regardless of whether we are demarcating structural components or stratifying and naming the structures, all of them require further understanding and deliberation.

### III.

Oil and gas in the East China Sea is mainly concentrated in the marine basins of the East China Sea, that is, within the East China Sea continental shelf basin, the Diaoyu Islands Uplifted-Folded Zone and the Okinawa Subsidence Zone. The East China Sea Subsidence Zone is the most important of the three. The main reason for this is that these three areas have sedimentation centers of enormous thickness and can provide an abundant material foundation for the formation of oil and gas. Also, because these secondary-level basins have a criss-cross distribution within them, there are structures of enormous scale and some have multiple structures. These supply the conditions for large numbers of oil and gas accumulation traps. For example, Changheng in Zhejiang is an area with excellent oil- and gas-bearing conditions. It is on the side of a sedimentation center more than 10,000 meters thick that should supply substantial oil sources. Moreover, the structure covers a large area and has been damaged little by fracturing, so it is capable of accumulating large amounts of oil and gas. In this structural belt that is 400 kilometers long from north to south, the north is higher than the south and it is possible that the Tertiary system was subject to denudation in the north. For this reason, the thick Tertiary deposits in the southern part should be superior to the denuded northern part. In addition, the formation and development of the basin was of course influenced by the subduction of the Pacific Plate and the effects of tension fracturing in the Okinawa Trench. Thus, the central and western parts of the East China Sea Subsidence Zone, especially the region to the west of the large rift zone on the eastern flank of the subsidence zone, should have conditions that are more suitable for the accumulation of oil and gas than does the eastern part. In the same manner, the Dandong, Wendong, Taipei, Diaoxi, Pengbei and other structural zones are all excellent oil- and gas-bearing regions and should be given our attention.

As we understand, the production of oil and gas on the northwestern part of the landmass of Taiwan Province began in 1904. In 1977, Taiwan was producing 4,000 barrels of oil a day from the lower and middle Miocene systems and 160 million cubic feet of gas a day from Miocene sandstone. The Japan Petroleum Company drilled down 4,065 meters with the Fujiang No. 1 well at the northern tip of the East China Sea Depression. They hit five natural gas layers from 860 to 2,500 meters as well as seven oil layers and five gas layers from 1,600 to 3,000 meters. This shows that oil and gas have already been found at the southern and northern tips of the East China Sea Subsidence Zone, and

that it is entirely possible that petroleum and natural gas can be found in even greater amounts near the sedimentation centers. At the least, the Longjing No. 1 well in the East China Sea found indications of high-pressure oil and gas in 1981 and the Longjing No. 2 well obtained an excellent natural gas flow in 1982. This shows that there are prospects for oil and gas on the East China Sea continental shelf. The only problem is in our work.

In oil and gas exploration in the East China Sea, however, it will not be possible to find anticlinal structural oil reservoirs if we only concentrate our attention on the structural zones near the three sedimentation centers mentioned above. Despite the fact that we should pay attention first of all to this type of oil and gas trap during marine oil and gas exploration, there is still a great deal of work to do on even simple anticlinal traps.

The enormous material foundation for petroleum and natural gas in the East China Sea Subsidence Zone and the unusually high terrestrial heat gradient are excellent conditions. For this reason, apart from anticlinal structures, there is also a possibility that oil has accumulated in the large number of nose-shaped traps. Neither should we ignore fault traps. We should ascertain the various types of traps like those mentioned above at medium depths of burial in order to further expose the petroleum potential under the continental shelf.

It was pointed out earlier that there are different fluvial flows and sedimentary deltas from different periods on the East China Sea continental shelf. We should intensify our work, set forth the relationships between deltaic facies sediments and oil and gas, and then provide the sedimentary theories for the oil- and gas-bearing properties of the East China Sea continental shelf to guide exploration for lithic oil accumulations. The rapid and substantial sediment buildup in the fluvial deltas is favorable to the burial of organic matter. The unusually high terrestrial heat gradient is favorable for the transformation of organic matter. This has been confirmed by oil and gas exploration in trench regions throughout the world. In the final analysis, however, fluvial deltas are not stable sedimentary environments and should therefore influence the maturity of petroleum. This is one of the primary reasons that natural gas but no petroleum has been found on many continental shelves (e.g., the Gulf of Siam). For this reason, there are three areas of research work where there should be rapid progress. The first is to use the modern to explain the ancient by gaining a comprehensive understanding of modern sediments and by studying Pleistocene and Holocene sedimentation patterns based on the special characteristics of sedimentary facies. This will permit us to explore the distributional characteristics of Miocene sediments that are closely related to the generation and accumulation of oil and gas. The second is to undertake a survey of the developmental history and paleogeography of lithic facies in the Chang Jiang Delta. The third is to give full play to the capabilities of electronic computers for processing seismic reflection data and develop research on seismic stratigraphy. If we integrate work in these three areas, then it will be possible to clarify the distributional laws of the sediments and the structural components of the East China Sea Continental Shelf over space and

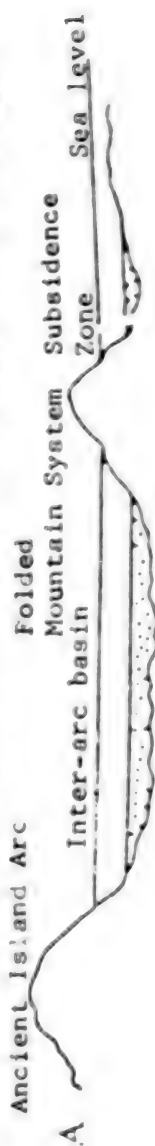
time. This will more clearly point out the direction to take in oil and gas exploration.

Of course, the use of electronic computers is also extremely important in the derivation of velocity parameters from seismic reflection tape recordings, in developing spot and mean point technologies and in deriving direct oil and gas indicators. However, we also must fully utilize the information supplied by gravitational, magnetic and other geophysical exploration methods for mutual verification and comprehensive research if we wish to have increased success in our work.

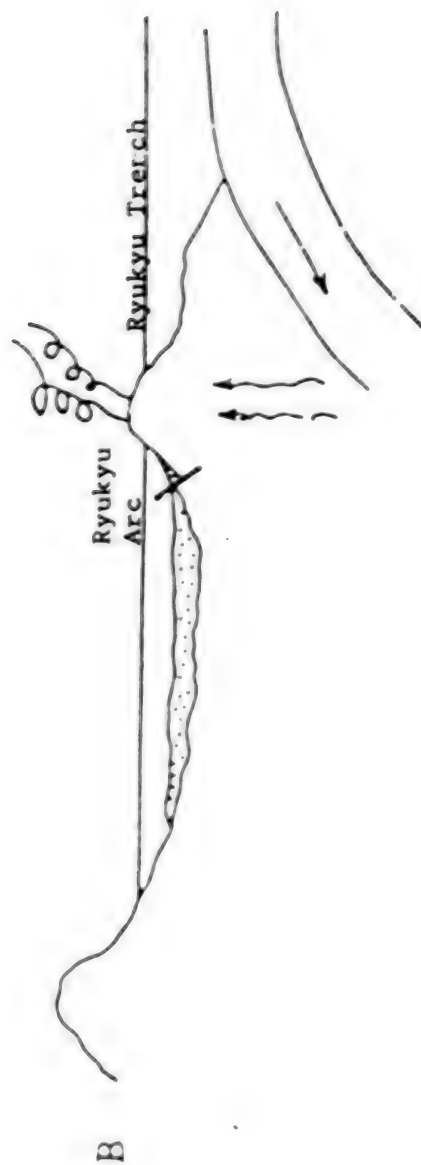
The oil- and gas-bearing characteristics of the East China Sea are closely related to the sedimentary environments and structural conditions of the broad marine expanse. The sedimentary environments and structural conditions of the area are controlled by the relative movements caused by the subduction of the Philippine Sea Plate under the Eurasian Plate. For this reason, comprehensive surveys of the primary characteristic of the area--the convergence of the margins--and intensive research on the trough-arc-trench formations of the East China Sea and the formation and evolution of the inter-arc basins are of extreme importance not only because of their great theoretical significance, but also for practice in guiding oil and gas surveys and exploration and for evaluating the oil- and gas-bearing characteristics of the region.



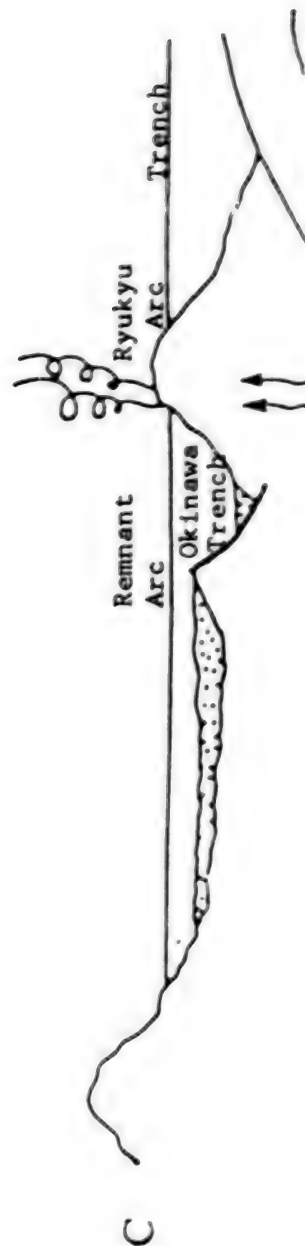
Figure 2. The Formation and Evolution of the Trench-Arc-Trough in the East China Sea Region



Early Tertiary to  
Early Miocene



In the middle part of the  
Miocene, the Philippine  
Plate began being subducted.  
The Ryukyu Trench appeared  
and fracturing occurred on  
the western flank of the  
Ryukyu Arc.



From the later part of the  
Miocene to today, the Okinawa  
Trench appeared between the  
Ryukyu Arc and the remnant  
arc and has undergone  
continuous expansion.

12539

CSO: 4013/84



## OIL AND GAS

### PETROLEUM POTENTIAL OF NORTHWEST CHINA DISCUSSED BY EXPERTS IN KARAMAY

Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese No 4,  
Dec 83 p 382

[Article title: "The Northwest Region Petroleum Exploration Conference Held at the Karamay Oilfield"]

[Text] The Ministry of Petroleum Industry convened the Northwest Region Petroleum Exploration Conference at Karamay Oilfield from 20 to 31 Aug 1983. State Council member Kang Shi'en [1660 0013 1869] and more than 200 representatives from the Xinjiang Uygur Autonomous Region, the State Planning Commission, the Chinese Academy of Sciences, the Ministry of Geology and Mineral Resources, oilfields and institutions of higher education attended the conference. The famous Chinese earth scientists Comrades Sun Dianqing [1327 3013 0615], Zhu Xia [2612 1115], Guan Shicong [7070 1102 5115], Liu Guangting [0491 0342 7844] and others also attended.

The conference carried out earnest summarization, discussion and planning related to the current situation in oil and gas surveying and exploration in the region, the direction of exploration and work arrangements for exploration up to 1990, and the consolidation and strengthening of exploration forces in the western region. The representatives at the meeting had a broad field of vision, liberated their ideas, aired their own views and earnestly analyzed and discussed the petroleum geology conditions of the region and the prospects for oil and gas and the latent oil and gas reserves in each region of Asia. The conference felt that the basic directions and principles for oil and gas exploration in the region are to persist in comprehensive regional exploration in the areas already known to have abundant oil and gas resources such as the Karamay--Urho Rift Zone in Junggar, the Zhundong Wusaiwan--Jimsar region, the Kekeya region in southwestern Tarim, the Gasiku--Dongchaishan, Honglingquan--Beimusi and Ganchaigou--Youquanzi regions of Qaidam, the Jiuxi Basin, the fracture zone in the northwest part of the Shanganning Basin and other zones and regions, and to make the greatest efforts to adopt advanced technologies and concentrate substantial forces for fighting a hard battle, to develop an organic integration of exploration and development, and use less manpower and equipment to achieve X X 100 million tons [as published] of reserves before the year 1990 and to prepare the oil and gas reserves and production capacity to meet the needs of reorienting the focus to the greater northwest as required by national economic construction.

The conference agreed to the arrangements for several campaigns in the near future and proposed six zones for preparation for exploration and six zones of preparation for regional or large profile seismic work. It studied important measures for consolidating and strengthening exploration forces in the western region and especially emphasized the need to rely on advances in science and technology and to concentrate on human resources training. At the same time, we should build our ranks stronger and guarantee the achievement of a major turnaround in petroleum exploration in the region and open up a new situation in petroleum exploration.

12539

CSO: 4013/84

## OIL AND GAS

### ACADEMIC FORUM ESTIMATES QAIDAM'S HYDROCARBON POTENTIAL

Jiangling SHIYOU YU TIANRANQI DIZHI [OIL AND GAS GEOLOGY] in Chinese No 4, Dec 1983 p 440

[Article title: "Academic Forum To Evaluate the Oil and Gas Resources of the Qaidam Basin Held in Dunhuang"]

[Text] The Petroleum Geology Society of the Chinese Petroleum Association and the Qinghai Province Petroleum Society jointly convened an academic forum to evaluate the oil and gas resources of the Qaidam Basin in Dunhuang, Gansu Province from 8 to 13 Aug 1983. The forum was convened to further explore and develop the rich petroleum and natural gas resources of the Qaidam Basin, to summarize and exchange achievements and experiences in the evaluation of oil and gas resources and to clarify the future directions and tasks for exploration.

Nearly 100 people from the Ministry of Petroleum Industry, the Chinese Academy of Sciences, the Ministry of Geology and Mineral Resources and institutions of higher education attended the meeting. The forum received more than 30 articles, 18 of which were presented at the meeting.

The meeting heard specialized research reports from the Qinghai Petroleum Management Bureau of the Ministry of Petroleum Industry, the Ministry of Geology and Mineral Resources, the Lanzhou Geological Research Institute of the Chinese Academy of Sciences and related comrades from Northwestern University. The reports concerned comprehensive research on evaluation of the oil and gas resources of the Qaidam Basin, sedimentary facies, structures and calculation of resource amounts. The representatives held comprehensive discussions on all types of questions related to the evaluation of oil and gas in the Qaidam Basin. The famous geologist Zhu Xia [2612 1115] spoke at the forum, as did many other comrades, including Min Yu [7036 6276], Bao Ci [0545 5412], Wu Chongjun [0702 1504 4596], Hu Jianyi [5170 6015 5030], Xu Wang [1776 2489], Zhang Jiahuan [1728 1367 3883], Huang Difan [7806 4574 5672], Gan Kewen [3927 0344 2429], Tang Xiyuan [3282 6932 0337] and Huang Hanchun [7806 3352 4783]. They presented valuable opinions on the evaluation of the oil and gas resources of the Qaidam Basin and on further exploration from many areas, including structures, sedimentary facies, geochemistry and other areas.

All of the delegates at the forum felt that there are broad oil- and gas-bearing prospects for the Qaidam Basin and that the potential oil and gas resources are very great, but that there needs to be strengthened research on basic questions in petroleum geology. The three basic tasks for regional exploration in the future are: 1. To look for new source depressions and to achieve the replacement of basic oil resources (although the oil-generating lithic bodies in the known Mangya source depression are large in scale, they are not rich in organic matter. We should speed up development of the Yiliping depression and the mid-Paleozoic source depressions of the northern part). 2. To develop Paleozoic geological investigations at the margins of the basin to understand the distribution of the Paleozoic boundary within the basin and its oil and gas prospects. 3. To fully understand the boundaries of the basin and clarify its internal structures in order to more intensively study the formational mechanisms and evolutionary history of the basin. The forum proposed three new spheres of exploration for creating a new situation: 1. Search for Paleozoic oil-bearing nappes. 2. Make a breakthrough on the deep strata of the fault boundary at Kunbei. 3. Change the exploration situation in the northwest part of Qaidam, strengthen research on reservoir strata and search for hidden oil pools.

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## OIL AND GAS

### DEVELOPMENT AND USE OF OIL SHALE RESOURCES EXPLORED

Beijing ZHONGGUO DIZHI [CHINA GEOLOGY] in Chinese No 3, 13 Mar 84 pp 16-17

[Article by Zhao Longye [6392 7127 0673] and Yang Meiling [2799 5019 0134]]

[Excerpts] Oil shale is a high-ash sapropelite. To qualify as a commercial ore deposit, its oil-bearing rate should exceed 5 percent and its calorific capacity should be in excess of 1,800 kilo-calories per kilogram (standards vary by country and over time). Oil shale forms in lake (or ocean) basins whose water depths are between 10 and 100 meters and, in addition, is far removed from its sources. The granulometric measure of most of the terrigenous clastics is less than 0.01 millimeter, and none is larger than 0.1 millimeter. The composition includes carbonate and alumina-silicon, and its associated elements are barium, vanadium, and nickel. The geologic period for the formation of oil shale deposits extends from the Cambrian period to the Tertiary era, a period longer than that required for the formation of coal deposits; there also is a wide variance among sediments in water depth. According to the estimate of C. O. Hook (1982), if the amount of oil shale resources in the world were converted on the basis of a greater-than-9 percent oil-bearing rate, the total amount of shale oil would reach 24.6 billion tons, a figure far greater than that of the earth's petroleum resources. Even if calculations were based on more conservative estimates, such as that of I. Opik (1982), there are approximately 630 billion tons of shale oil resources, of which the U.S. has 280 billion tons, the U.S.S.R. has 120 billion tons, Brazil has 110 billion, while China follows in fourth place.

China has a rather long history of mining oil shale. The oil shale industry was established in Fushun in 1928 and was put into production in 1930. The Maoming oil shale base was built after liberation. During the period of the first and second five-year plans, the output of shale oil accounted for a large proportion of crude oil production. During the 1950's, oil shale was considered a priority mineral product and reconnaissance survey and exploration was conducted. Since the 1970's, however, utilization of oil shale resources has been neglected. Today, Fushun utilizes its high-grade oil shale only, while the mining of oil shale has practically stopped at Maoming and the facility has been set aside for future use.



China has abundant oil shale resources. There are 14 provinces and regions which are now known to possess these resources, the most significant of which are the three provinces of Jilin, Guangdong, and Liaoning. Based on the data in hand and in comparison with oil shale deposits abroad, China is short of large-scale and early-period sea facies type deposits. This has been determined by our country's geological conditions. Although each era since the Cambrian period has possessed a structure for the formation of oil shale, namely, a sediment environment, since the Mesozoic and Cenozoic eras' tectonic activity has been intense in many regions and the geothermal gradient has been quite high; this has intensified the degree of metamorphism for organic matter and has been unfavorable for the late-stage preservation of oil shale. Therefore, when searching for and studying conditions for the formation of oil shale deposits, we must study the organic metamorphic action in each region and each layer. Now we can use the distribution of the coal metamorphism zone to deduce the conditions for late-stage preservation of the oil shale layer.

In other countries many huge carbonatite-associated oil shale deposits formed between the Cambrian and Silurian periods; in China, highly-metamorphosed sapropelitic anthracite (popularly called bone coal) and corresponding carbonolite are preserved in southern Shaanxi and northwestern Hube. The sediment situation is similar. Abroad, many of the graptolite shales of the Ordovician and Silurian periods are oil shales; those in China, however, are black shale.

In southern China, conditions during the Devonian period were conducive for depositing sea facies sediment. It is already known that western Guangdong has anthracite coal, and it may be deduced that corresponding layers of sapropelitic coal and oil shale are also there.

The degree of universal metamorphism of coal formed during the Carboniferous period is higher. The Ceshui coal system in southern China and the Taiyuan group in northern China, in such places as Qinshui, Yanquan, and Jiaozuo, are all anthracite; the preservation of oil shale layers is impossible. However, oil shale layers are found among corresponding layers of shallowly metamorphosed coal. For example, Hedong coal field's Taiyuan group in Shanxi contains seven layers of oil shale; the corresponding coal bed's coal rank is gas-coal. Hunyuan coal field's coal rank is parabituminous coal; the Taiyuan group includes 0.2-0.7 meter oil shale. Yanzhou's fifteenth upper coal layer in Shandong can intergrow into oil shale and its coal rank is gas-coal. The capacity of this kind of oil shale deposit which is associated with coal will not be too great.

In Xinjiang a huge oil shale deposit was formed during the Permian period. It extends for 100 kilometers from Yaomoshan in the west to Jimsar in the east. From the early Permian period two layers of oil shale not associated with coal developed in the Daxigou group; it is a large reserve. In southern China, the conditions for later-stage preservation are lacking because the degree of permocarboniferous metamorphism is too high. However in western Hunan, in the layers equivalent to Wujiaping's limestone, the coal

rank is rather low; that is, it is gas-rich coal. So there is hope that oil shale might be found.

The oil shale layer of the Triassic period is mainly stored in the extension group strata in northern Shaanxi and is distributed over a wide area. For example, there is an oil shale bed between Bin Xian and Tongchuan in Shaanxi, its thickness runs from 9.5--14.6 meters and its corresponding coal rank is open-burning coal. An oil shale bed also is intercalated at the Wayaobao group in the region between Zizhang and Yulin; it runs 3 meters thick and its equivalent coal rank is gas coal. The total area of the Ordos Basin in northern Shaanxi is quite large and the degree of coal metamorphism is low. Its extension group is an interior lacustrine facies sediment area that is short of coal-bearing sediment. The basin should prove to be a promising site for oil shale.

The oil shale of the Jurassic period is usually associated with coal. Except for the Ordos Basin, the area involved is quite small. The corresponding coal rank is gas-long-burning coal. The highest class does not exceed fat coal.

The areas of oil shale deposits of the Cretaceous period, so far as we are relatively small. Most of them are associated with volcanic clastate. They are widely distributed over an area extending through Liaoning and Jilin.

The Tertiary Era is a geological period which promises to have been very good for the formation of oil shale deposits in China. Aside from those known deposits at Fushun, Maoming, and Huadian which have already been developed and utilized, the most promising areas are in the lower Liaohe Basin and in the Fushun-Mishan fault zone. In these areas, oil shale beds similar to the Fushun oil shale beds have been found above the coal beds.

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## OIL AND GAS

### TEST WELLS MAY HAVE HIT NEW DAGANG POOL

OW270653 Beijing XINHUA in English 0630 GMT 27 May 84

[Text] Tianjin, 27 May (XINHUA)--New oil-bearing structures have been discovered in the southern and northern parts of the Dagang oil field and a high-yield oil and gas well was drilled in the central part of the field, according to oil field officials.

Test wells drilled in April showed a good flow of oil and gas of industrial value in the southern part of Dagang. It is most likely a new oil pool, officials added.

At the same time, crude oil gushed out of shallow wells around the Gaonan area in the northern part of Dagang. This opened up new oil prospects in this part of the field.

Oil field officials said that the central part of the field will be a high-yield zone as a test well completed in early May yielded 267 tons of crude oil and 33,000 cubic meters of natural gas a day.

CSO: 4010/95

## OIL AND GAS

### HIGH YIELD FROM NEW SHENGLI WELL REPORTED

OW251738 Beijing XINHUA in English 1652 GMT 25 May 84

[Text] Jinan, 25 May (XINHUA)--A newly drilled well at the Shengli oil field in Shandong Province is producing over 2,700 tons of crude oil and 210,000 cubic meters of natural gas a day, according to production tests published today.

The well has reached ordovician pyroxenite, where the oil-bearing structure is 81.8 meters thick. The quality of both oil and gas is satisfactory, an oil field official says.

Earlier, a gas well with a daily output of 189,000 cubic meters was sunk at a pre-cambrian granite-gneiss gas structure at Shengli, opening up new areas for oil and gas exploration.

Shengli, China's second-largest oil producer after Daqing, produced 5.01 million tons of crude in the first quarter of this year.

CSO: 4010/95

## SUPPLEMENTAL SOURCES

### CHINA'S PROGRESS IN OCEANIC ENERGY RESEARCH REVIEWED

Baijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 1, 25 Feb 84 pp 9-11

[Article by Xu Qiwan [6079 0796 2598] of the Institute of Marine Scientific and Technological Information of the National Bureau of Oceanography: "Development and Research on Oceanic Energy Resources in China"]

[Text] Oceanic energy refers mainly to the energy contained in the oceans themselves, such as tidal energy, wave energy, tidal current energy, oceanic thermal energy, oceanic differential density energy and so on. Research on using new energy resources (including solar energy, wind energy, oceanic energy, etc.) has been going on for 20 years, and is now being speeded up. The United Nations Conference on New Energy Resources and Renewable Energy Resources held in Nairobi in 1981 stressed discussions of the goals and strategies for developing various new types of energy resources, including oceanic energy, as well as several concrete problems of development and technology. This shows that R&D on new energy resources has already attracted the attention of the entire world.

In foreign countries, oceanic energy is one of many new energy resources. Its potential, advantages, and value are being acknowledged by more and more people. Oceanic energy also has its weak points. Like other new energy resources, oceanic energy resources have small density, require enormous facilities for development and utilization, involve difficult engineering techniques, have high requirements for engineering materials, are very expensive, and so on. Research in the past 10 years has shown, however, that there is not only hope for but also the possibility of development and utilization of oceanic energy. Two projects which are the main indicators of the substantial progress made in development and research on oceanic energy resources during the 1970's. One was the successful testing of "small-scale oceanic thermal energy exchange equipment" carried out in 1978 in the U.S. on the ocean surface in Hawaii. The temperature differential between the surface and deep layers of seawater was used for generation of 50 KW of electricity. The second project was the experimental "Kaimei" wave energy power generation ship off the coast of Japan from 1978 to 1980. The power generation capacity reached 1 MW and there was even a successful experimental transmission of power to the coast. Looking at current developmental trends, construction on several large-scale tidal energy power generation stations will begin in the 1980's. Experiments and research on power generation using



oceanic thermal energy and wave energy will continue to be carried out on an even larger scale. It is estimated that large-scale development of power generation using oceanic energy may be possible by the beginning of the next century.

Development and research on oceanic energy in China began in the 1950's and mainly involved research on power generation using tidal energy. Domestically, construction has been completed on almost 10 small-scale tidal energy power generation stations, mostly along the coast of Zhejiang Province. The total installed capacity is about 4 MW. The largest among them is the Jiangxia tidal power station in Leqing Bay off Zhejiang. The design total installed capacity is 3 MW and the first generator set (500 KW) went into operation in 1979. The second largest is the Baixiakou tidal power station in Rushan County, Shandong Province, with an installed capacity of 960 KW. Jiangxia is an experimental state-run tidal power station, and is the second-largest in the world, next to the Rance tidal power station in France (2.4 MW). The other small-scale tidal power stations are locally-run and have obvious economic benefits. They have already attracted the attention of related departments.

Research on power generation using wave energy began in Shanghai in the 1970's. A small-scale wave energy power generator was developed a few years ago. It can generate electricity with a gentle breeze and 0.2 meter waves. The maximum capacity is 60 watts, and the electricity generated in one day can power a maritime beacon for 3 days. There are also several other units which are currently doing research on small-scale wave energy power generation. Research currently being done abroad on wave energy power generation also involves mainly small-scale wave energy power generators, and they are already being marketed for powering naval beacons. Thus, there are no substantial differences between China and other countries. Furthermore, some people in China have researched and designed a "wave turbine" which is unique to our country. It was successfully tested in Shanghai in January of 1973. An average of 20 to 30 watts of power was generated with 30-meter waves. A prototype "wave-powered submersible" has also been designed on the same principle. Although it was not put into use, this invention created a new route for opening up research on wave energy utilization in China.

There is a middle-aged peasant in Danshan Prefecture, Zhejiang who spontaneously developed and studied the utilization of tidal currents for power generation. The prototype tidal current generator that he made was tested in Shanghai and was able to produce electricity. Later, due to technical, funding, administrative, and other reasons, there were no further advances. There has also been no research done in the area of oceanic thermal energy and differential density energy.

According to recent statistics, there are now more than 30 units in China which are involved in research related to oceanic energy resources, development techniques and information. Despite this, development and research on oceanic energy in China is still basically administratively decentralized.

and has not been included in centralized planning. This has led to many problems and slow progress. There are technical and economic problems here, as well as administrative problems and questions of understanding.

The research and development on oceanic energy that we are speaking of here refers primarily to long-term development and work prior to development. This is especially true for developing new energy resources. The creation of something that did not previously exist and the movement from research to application often requires more than a decade or even several decades. Research and development work should stand in the forefront.

We will now offer some viewpoints on important questions in development and research of oceanic energy:

### 1. On the Question of the Advantages of Oceanic Energy Resources

Many people have now seen the advantages of oceanic energy resources. However, are there advantages to the development and utilization of oceanic energy resources in the energy resources of China? What are their statuses and potential roles? It appears that these are not very clear. Some estimated statistics are provided here for reference.

Tidal energy resources are the only resources in China which have been formally surveyed and calculated. The most recent results are: the potential tidal energy generation capacity which can be developed and utilized along the coast of the mainland is 20,000 MW, with annual power generation of about 58 billion KWH. None of the remaining oceanic energy resources has been formally investigated and evaluated. According to preliminary statistics, wave energy along the mainland coast amounts to about 150,000 MW, of which about 30,000 to 35,000 MW can be used. The wave energy of the entire China Sea has been theoretically calculated as more than 500 million MW. Assuming that just 1/1000 of this could be used, it would still leave more than 500,000 MW. Oceanic thermal energy is concentrated in the South China Sea. It has been estimated roughly that about 500,000 MW can be developed and utilized. The energy from seawater density differentials near the mouths of the Chang Jiang, Huans He, Zhu Jiang, and other primary rivers is estimated at more than 100,000 MW. There is also oceanic current and tidal current energy, which has not been estimated. The total national installed generator capacity in 1980 was over 100,000 MW, with 300.6 million KWH of power being generated annually. The enormous potential for oceanic energy is obvious in comparison. In terms of tidal energy, which has been formally investigated, if all of the tidal energy along the mainland coast was exploited, then the total power generated would be almost 1/5 of the total national power generation in 1980.

Looking at the special characteristics of oceanic energy, the oceanic energy resources of China have important advantages in local energy resources, especially tidal energy in eastern China. The total installed generator capacity in eastern China in 1981 was 10,370 MW, with power generation of more than 50 billion KWH, mainly from burning coal. Half of the coal is

supplied by the region itself and the other half if supplied by other regions (more than 10 million tons from each). Currently, there is an annual power shortage of about 30 percent. Related departments have predicted that thermal power generation must be increased by more than 9 billion KWH by 1985, which altogether would require an additional 6.7 million-plus tons of coal. The region itself can only provide an additional 2 million tons, which means that even if the entire amount was supplied to the power industry, more than 4.7 million tons would still be needed from other regions. By 1990, assuming power generation of 90 billion KWH, the net increase in thermal power generation would be 18 billion KWH, which would require an additional 10 million tons of coal. The region itself, however, can supply only 4 to 5 million tons, which means other regions would have to supply 5 to 6 million tons. That is to say, by 1990, 15 to 17 million tons of coal would be needed from other regions each year. It is obvious that there is a shortage of oil and coal in the eastern China region, and that hydropower resources are also limited. If the supply of energy resources depends solely upon mineral fuels, there will be increased shortages and greater pressure on rail transportation. There are abundant coastal tidal energy resources in the eastern China region, however, equal to more than 90 percent of total national tidal energy resources. The installed capacity is 19,000 MW, which greatly exceeds the existing installed generator capacity. It has already been confirmed that the three regions at the northern mouth of the Chang Jiang, the Qiantang Jiang and Leqing Bay are the areas with the greatest potential for development of tidal energy power stations. The predicted installed capacity is as much as 60,000 MW. If only a portion of this is developed and utilized, it can promote prosperity in the Shanghai, Hangzhou, and Ningbo economic triangle, and also greatly reduce the electrical power shortage in the entire eastern China region and lessen the pressure on transportation. For this reason, active development of conventional energy resources to solve the energy problem in the eastern China region should also give consideration to oceanic energy. The first is development and utilization of tidal energy resources. Adapt to local conditions, promote the advantages and avoid the disadvantages, open up multiple routes to energy resources, improve the structure of energy resources, and do not seek far and wide for what lies close at hand. These are important questions which should be considered in national energy resources planning.

## 2. On the Question of the Economics of Developing Oceanic Energy Resources

In overall terms at present, the economics of power generation using oceanic energy resources cannot be compared with conventional energy resources. This is, however, a problem that is common to all new energy resources, and oceanic energy resources are not exception. The main reasons for the current lack of progress in tidal energy power generation, which is relatively mature in development and technology, are "large investments and long construction periods". The average investment for construction of a large tidal energy power station is about 2,000 to 4,000 yuan per KW, while the average investment for construction of a large thermal power station is only 613 yuan per KW. The investment for the tidal energy power station is 4 to 6 times greater than that for a thermal power station. Construction of a single tidal energy power station using money which could build 4 to 6 thermal power

power stations is obviously not economical. This is, however, only one side of the question, and we must look at another side. Tidal energy power stations use water as an energy resource, and require no fuel after they are constructed. Thermal power stations burn coal and require investments for coal mine construction. Transportation of the coal depends on rail transportation. There also must be additional environmental protection equipment. All of this costs money. In the past, all of these expenditures were accounted for separately, and only the construction costs for the thermal power plant itself were considered. This has led to a misunderstanding. According to statistics, the investments per KW for construction of a large thermal power plant are about 350 yuan for coal mine construction, about 250 yuan for railroads, and about 120 yuan for environmental protection. Combined with the expenses of power plant construction, the investment is more than 1,300 yuan per KW. The two investments can be similar if we consider technical progress and decreased costs for development of tidal energy power stations as well as future price increases for conventional energy resources, even to the degree that the tidal energy power station might be cheaper. This point was seen at the beginning of the 1970's at the "International Tidal Energy Resources Research Conference". The conference pointed out: "In the past, the investments for tidal power stations were high, but this situation has been completely reversed now as a result of technological developments. However, due to the shortage of coal and the additional necessity of controlling pollution, the development of conventional power stations may, in contrast, require substantially increased investments."

Discussion of economic benefits should not be limited to investments. Power generation using oceanic energy provides many benefits from comprehensive utilization. If tidal energy power generation projects are integrated, they can be combined with marine products cultivation, tideland reclamation, irrigation, fruit trees, communications, tourism and so on. This leads to a major increase in benefits and reduces the cost. There is no comprehensive utilization of tidal power generation in China at present, only experimentation. There are obvious economic benefits, however. The Jiangxia tidal power station, for example, has done some experimental tideland reclamation, with yields of more than 1,200 jin per mu. Four of the small-scale tidal power stations in Zhejiang raises shellfish with a production value of 100 to 500 yuan per mu, the highest being 900 yuan. In contrast, there are few projects for comprehensive utilization in thermal power generation stations.

There is also the question of "long construction periods." Like hydropower stations, tidal energy power stations require longer construction periods than thermal power stations and the benefits are long in coming. This is a fact. It is estimated that a large-scale tidal energy power station requires 6 to 10 years for construction, while a large thermal power station requires only 3 to 5 years. If we look at the problem in overall terms, however, and include the construction periods for coal mines and railroads, then the time period is longer than that for a tidal energy power station. This is due to the fact that construction of a large coal mine requires 10 to 15 years from the time construction begins to when coal is produced. Thus, it is restrictive and incorrect to say sweepingly that tidal energy power stations require large investments and have long construction periods.



### 3. On the Question of Developmental Planning for R&D on Oceanic Energy Resources

Taking China's national conditions as the starting point, we can conceive of the long-term goals of development and research in oceanic energy in China as being to reach the level of utilization of large-scale tidal energy power stations by the end of the century, and to do preliminary research on the other types of oceanic energy utilization and achieve technological breakthroughs by the beginning of the next century. The focus should be placed on development and research in tidal energy power generation. The short-term goals during the Sixth Five-Year Plan are to earnestly summarize the experiences of the Jiangxia tidal power station, to further strengthen experimentation and research, to give full play to its role as an experimental base area, and to become involved in site selection and survey and design work for medium-scale tidal power stations. Small-scale tidal energy power stations should be actively developed with adaptation to local conditions, stress applicability, and be locally operated with public assistance. The state should provide policy and technical assistance and consideration. Research on wave energy power generation should consolidate and improve upon the achievements in small-scale wave power generation equipment and there should be preliminary research work on medium-scale wave energy power generation equipment. The feasibility of development and utilization of oceanic energy should be made known. In the Seventh Five-Year Plan, we should begin construction of medium-scale tidal energy power generation stations and carry out research on site selection and feasibility of large-scale tidal power stations.

### 4. On Key Technological Questions

Development and research in oceanic energy is a comprehensive realm of science and technology. It touches on a wide range of areas, involves complex technologies, is quite difficult, and requires cooperation among all scientific and technical departments. In terms of certain key projects for development and research, we must centralize our strengths, attack key technical problems and strive for key breakthroughs to rapidly create a new situation. Based on the tentative plans for development of oceanic energy resources in China, the key points and the main problems at present, I propose giving consideration to the following three aspects for developing technical cooperation and technical breakthroughs:

- 1) Investigation and evaluation of oceanic energy resources, mainly including the abundance, special characteristics and natural laws of energy resources. Basic work in development, research and planning in oceanic energy resources should be placed in the forefront. If the situation is unclear, then there is no way to carry out scientific planning and formulate concise plans for development. I propose that there should be cooperation between marine environmental management departments and energy resources development departments.

- 2) The main technical problems in tidal energy power generation, including development and research on silt accumulation, seawater corrosion, biological



contamination, large-scale tidal power stations generator sets, floating construction techniques, automatic control of tidal power stations and so on. I propose that water conservancy departments cooperative with related departments and organize attacks on key technical problems.

3) Research on comprehensive utilization in development of tidal power stations and other oceanic energy resources.

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CSO: 4013/116

## CONSERVATION

### COAL INDUSTRY HAS ENORMOUS POTENTIAL TO CONSERVE ENERGY

Beijing NENG YUAN [JOURNAL OF ENERGY] in Chinese No 1, 25 Feb 84 pp 7-9

[Article by Hao Fengyin [6787 7634 0603] of the Ministry of Coal Industry Processing and Utilization Bureau: "Energy Conservation and Measures in the Coal Industry"]

[Text] Coal output must reach 1.2 billion tons by the year 2000. In the construction of the Four Modernizations, coal industry departments undertake the heavy responsibility of developing coal, increasing output, engaging in energy conservation in the coal industry itself, and creating conditions for energy conservation in the society. These are difficult tasks.

#### I. Energy Conservation Is an Important Task in the Coal Industry

For a long period, the coal industry has had heavy production tasks, backward technologies, outdated equipment and great pressures in production. Attention has been paid only to completion of output tasks, with no concern for conservation. This single product comes far from meeting societal demand. Some people have a very weak concept of energy conservation. They feel that they are "living in a sea of coal, so coal conservation has no real significance." There is severe waste of energy resources in coal mines. The mines themselves used around 14 million tons of coal in 1982. This is about 4 percent of coal output when converted to standard coal, the 5th highest among the ministries (apart from metallurgical, electric power, construction, and other ministries). The enormous potential for energy conservation is shown primarily in:

##### 1. Extremely weak basic administration work.

Energy use is unplanned, there are no consumption quotas and the phenomenon of "eating from the big common pot" is fairly serious.

##### 2. Backward production techniques and technical equipment.

Large amounts of energy are consumed during the production process, the utilization efficiency of thermal energy is low and there is great waste. There are now more than 7,000 boilers in the country with unified distribution of coal. They have an average thermal efficiency of about 45 percent, roughly 10 percent lower than the national average. The thermal efficiency of some

steam locomotives used in mining regions is as low as 6 percent or less. The efficiency of some ventilators and water pumps used in coal mine production is 10 to 20 and 10 to 15 percent less than that of newer models, respectively.

3. High coal consumption in the mines themselves, with increases in recent years.

The unit consumption of coal in coal mining regions in 1979 was 391 tons per 10,000 tons of raw coal. Total electricity usage was 32.08 KWH per 10,000 tons of raw coal, and raw coal electricity consumption was 22.62 KWH per 10,000 tons. These figures were 411 tons, 35.88 KWH and 26.02 KWH, respectively, in 1982. National unified distribution coal mines produced 350 million tons of raw coal in 1982. Calculated at 1979 energy consumption levels, 700,000 tons of coal and 1.3 billion KWH of electricity were consumed in the mines. This serious waste of energy resources greatly influences the results of enterprises. Energy conservation work is a very important link for enterprises that wish to improve economic results.

Coal enterprises are also departments which produce energy resources, so energy conservation is also a form of increased production. Annual coal consumption in some mining bureaus has reached 1.5 million tons. This is a frightening statistic that shows the enormous potential for energy conservation. Great efforts to reduce coal consumption in the mining departments themselves or substitution of low thermal value fuels for high-quality raw coal will be equivalent to increasing production and can provide more high-quality coal for society.

## II. The Energy Conservation Situation in the Coal Industry

The Ministry of Coal Industry has given attention to energy conservation work in the ministry itself in recent years. It has strengthened management of coal used by the ministry itself and has carried out technical reforms for energy conservation. Some successes have been obtained in energy conservation plans during the Sixth Five-Year Plan clearly the direction of energy conservation.

### 1. Wider use of fluidized-bed boilers.

Experimentation and research in fluidized-bed fuels technologies has been strengthened in recent years and some achievements have been made under close coordination with related departments. The double-bed bone coal fluidized-bed boiler with a thermal efficiency level of over 70 percent that was researched and designed by Zhejiang University is an example. A lignite fluidized-bed boiler developed in the Northeast Mining Region has a thermal efficiency of more than 80 percent. There also have been substantial developments in their application. According to incomplete statistics, there are 570 fluidized-bed boilers nationwide in coal mining regions with 3,800 tons of steam equal to 25 percent of total coal mine boiler steam production. There are five fluidized-bed boilers with an installed capacity of 79 MW. It has been estimated that about 1 million tons of good coal can be conserved annually if the nation's coal mines burn 3.5 million tons of gangue each year.

## 2. Comprehensive utilization of gangue.

The Ministry of Coal industry has concentrated on the production of gangue construction materials on the basis of extending new technologies for gangue utilization. There are now 188 gangue brick factories in coal mines nationwide with a capacity of 1.6 billion bricks. There are 30 gangue cement plants with a production capacity of 500,000 tons. Some mining regions also produce aerocrete, hollow bricks and other construction products, and can conserve about 250,000 tons of coal each year.

## 3. Production of shaped coal for consumer use in mining regions.

Processing technologies for molded coal in mining regions has now moved from experiment to utilization. There are 20 bureaus and mines which supply their employees with molded coal for household use. The Huainan Xieyi [Jiangsu Province] mine uses coal slurry mixed with a small amount of coke powder for trial production of fuel honeycomb coal. There has been roughly a 30 percent saving of coal. All of the more than 8,500 employees of the Service Bureau of the Baisha Mine in Hunan Province use honeycomb coal, saving nearly 10,000 tons of coal annually. Mining regions have also obtained good results in gas utilization.

## 4. Reform high-consumption electrical equipment, conserve electricity.

In recent years, the nation's unified distribution mines and key coal mines have replaced or rebuilt 1,522 ventilators, water pumps, air compressors and other pieces of equipment, with an annual electricity savings of 150 million KWH. Extension of Pulse speed governors in electric locomotives, far-infrared and other new technologies have generally led to electricity conservation ranging from 20 to 30 percent.

Several measures have been adopted to strengthen electricity management:

1) conserving electricity in production, improving equipment efficiency and decreasing electricity consumption; 2) strengthening electricity dispatching, load regulation and peak avoidance, and improving load rates; 3) transforming public use of electricity into independent checks, with fee collection based on amounts used; 4) organizing economic transmission; and 5) collecting fees based on amounts used for household electricity usage. These measures have provided obvious results in electricity conservation.

The development of energy conservation work in the coal industry has promoted enterprise management and led to improvements in enterprise quality. More and more coal employees are coming to understand the strategic significance of energy conservation. According to incomplete statistics, the nation's unified distribution coal mines conserved 700,000 tons of coal in 1982. When added to electricity and petroleum conservation and converted to standard coal, the total savings were more than 800,000 tons.

## III. Energy Conservation Measures in the Coal Industry

In order to implement the spirit of the National Conference on Energy Conservation Work, the Ministry of Coal Industry convened the First National

Conference on Systematic Coal Energy Conservation Work in October 1983 and made comprehensive arrangements for future energy conservation work. The overall direction is: develop comprehensive coal utilization with integrated development of "selectivity, power generation, models and construction", use low thermal value fuels, make substitutions for high-quality coal, improve economic results, and create the conditions for conserving energy for society. This direction has already been included in long-term planning for the coal industry. Energy conservation work will gradually come to take the correct path. Based on the developmental needs of the entire national economy and the needs of the coal industry itself, coal washing will develop to more than 500 million tons by the end of the century (with more than 70 percent being washed). There will be more than 20 million tons of shaped coal, 99 gangue power stations, 3,000 MW of power generation and 30 million tons of cement and cement products, with a total energy conservation of about 30 million tons. The concrete tasks for 1984 are to reduce coal usage in the national unified distribution mines themselves by 5 percent below the plan, to conserve 700,000 tons of raw coal and to conserve 2 percent of electricity or 250 million KWH. The actual measures are:

1. Strengthen leadership, establish a perfect energy conservation structure.

In order to strengthen leadership of energy conservation work, the Ministry of Coal Industry has decided to: 1) readjust and strengthen small energy conservation leadership groups in the ministry and replenish working personnel in the ministry's energy conservation office; 2) establish special energy conservation organizations in the coal offices, departments and bureaus of key coal-producing provinces (and autonomous regions) under the responsibility of a single bureau-level cadre; in the other provinces (and autonomous regions), specialized personnel should be assigned to energy conservation work; 3) specialized energy conservation organs should be established in mine service bureaus which produce more than 1.5 million tons a year and in factories which use more than 10,000 tons of coal annually; other units should set up specialized personnel for energy conservation. The scope of their responsibility is: to earnestly propagandize and implement the energy conservation directions, policies and decrees of the state; to organize the compilation of annual and long-term energy conservation plans; to be responsible for energy management, supervision, and investigation of the implementation of energy conservation plans and the rational utilization of funds for energy conservation; to actively extend energy conservation technologies and new techniques; to summarize and exchange advanced experiences on energy conservation; and to do good work in technical training and technical consulting in energy conservation.

2. Strengthen management of energy resources, improve economic results.

In order to strengthen the management of energy resources and develop energy conservation work, the Ministry of Coal Industry formulated the "Provisional Methods for Investigation of Energy Resources Development" and carried out a comprehensive investigation of energy resources to clarify the structure of energy resources, the amounts consumed, utilization levels and the



potential for energy conservation. They determined the goals for energy resources management and technical transformation. They have implemented scientific management of energy resources based on an investigation of these conditions and are gradually installing measurement instruments and devices in a planned manner. Enterprises which consume more than 50,000 tons per year must install water, electricity, and gas meters for production and consumer usage in 1984. A consumption contract fee system was adopted at the beginning of 1984. Energy conservation should be promoted further by perfecting quota management and by application of the principles of "checking quotas, charging higher prices for excessive consumption, imposing penalties for exceeding limits, and selecting the best for supply."

### 3. Carry out technical reforms, extend new energy conservation technologies.

Good results in energy conservation depend on technical renewal and on adoption of new technologies, new techniques and scientific management. This is the key. This question will become even more obvious and necessary following more intensive development of energy conservation.

1) Transform low efficiency boilers. Complete the transformation of low efficiency boilers and the changeover from steam heating to water heating before the end of 1990. Make great efforts to extend the use of fluidized-bed fuel technologies. Utilization of fluidized-bed fuels provides rich resources which can be obtained locally and only have to be transported over short distances. The advantages of low transportation costs and multiple utilization provide good economic results. This Ministry of Coal Industry already considers this to be an important energy conservation measure.

2) Convert steam locomotives in mining regions to block coal or shaped coal burners. Shaped coal fuel has a high thermal utilization rate and causes little environmental pollution. It is an important path to energy conservation. The country currently has 519 steam locomotives in key coal mines that consume 1.8 million tons of coal annually. All of them should be converted before 1985.

3) Transform ventilators, compressors, water pumps, air extractors and other equipment. There are currently 5,454 pumps of various types which can be replaced or rebuilt within 3 to 5 years. The coal system is an industrial sector which consumes large amounts of electric power, and there is enormous potential for electricity conservation.

4) Develop gangue or low-sulphur coal pit-mouth power plants and make comprehensive use of gangue. Coal mines consume large amounts of electricity and have many capital construction tasks. They require large amounts of electric power and construction materials such as bricks, cement, etc. Large amounts of high-quality coal can be conserved by developing pit-mouth power plants in mining regions to supply electric power to coal mines and by utilizing slag from fluidized-bed boilers to make cement, blocks, bricks, and pre-fabricated parts. It also can promote construction in mining regions, improve economic results, create prosperity in mining regions and increase employment. It is a matter of gaining many benefits from a single thing.

5) Transform household cooking stoves, make full use of gas resources and extend the utilization of honeycomb coal. The thermal efficiency from burning raw coal is low. The nation extracts about 300 million cubic meters of gas. This is an excellent low-cost energy resource, but the current utilization rate is under 30 percent. In the future, mining regions should change over shaped coal or gas. This will conserve energy resources, improve the environment and raise the standard of living of employees.

6) Carry out technical integration in newly constructed mining regions. The Ministry of Coal Industry has carried out reforms of current design standards and provided finalized designs to encourage all-round development of coal mines. Coal products will gradually move in the direction of being completely washed and processed, being measured according to commodity coal and setting product types according to quality.

#### 4. Strengthen technical training work for energy conservation.

A common situation at present is that the science of energy conservation has not been popularized. The development of technical training is extremely important for improving energy conservation techniques for the broad masses of cadres and employees. The Ministry of Coal Industry has already drawn up a program for this purpose and is gradually carrying out training. The focus at present is on energy conservation administrative personnel at each level. The popular scientific knowledge and specialized knowledge related to energy conservation should be used for training cadres at all levels and in all types of work. The Ministry of Coal Industry has decided that: the Ministry and its departments and bureaus should arrange training for energy personnel in all factories under direct jurisdiction of the Ministry's departments and bureaus. The offices (bureaus) of each company and province (autonomous region) are responsible for training energy conservation personnel in mining services bureaus and mines (factories). Operations personnel involved in energy consuming work should be trained by the bureaus and mines (factories). After being tested and meeting specifications, the operations personnel can be issued a technical certificate of inspection. Anyone who does not have a certificate should not be permitted to engage in operations work.

In order to strengthen energy conservation, the Ministry of Coal Industry has decided to establish a national coal mine energy conservation technology service center in the Beijing graduate student department of the College of Mining to provide technical services and consultation.

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## CONSERVATION

### INVESTMENT AND RETURNS IN ENERGY CONSERVATION

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[Article by Qin Jingfeng [4440 2529 1496] of the Ministry of Chemical Industry Planning Academy: "Some Points of Understanding on Investments and Results in Energy Conservation"]

[Text] More intensive energy conservation work has made energy conservation increasingly difficult. Technology is also becoming more complex each day and a unit of investment in energy conservation will continue to increase. This is an inevitable trend. For this reason, using a unit of investment in energy conservation for evaluation of the results of energy conservation requires consideration of temporal factors so that limited capital can give rise to the greatest benefits. Different standards and different key investment points should be used at different times.

#### 1. Current Key Points of Energy Conservation

Energy conservation work may be divided into three stages: elementary, mid-level, and advanced. Following readjustment of the national economy, this line of work has already begun to move from an elementary stage of improved administration, stricter operations and reduction of necessary losses to a middle stage focusing on equipment updating and transformation.

In terms of industrial energy utilization conditions, most is used for thermal energy. Energy utilization efficiency in industrial departments, therefore, is determined primarily by boilers and their condition.

Industrial boilers (not including boilers used in electric power plants, locomotives, or ships) consume a substantial amount of fuel, equal to about one-third of the total national fuel consumption--more than 200 million tons of coal annually. Of this amount, small steam-producing boilers under 2 tons comprise about 30 percent of the total amount of evaporation from industrial boilers. These boilers are technically backward, have outdated equipment, consume large amounts of coal, cause severe pollution and have an actual efficiency of only about 40 percent. They should be the first to be transformed. Transforming these outdated boilers only requires small investments, provides rapid results quickly, and has fairly large benefits. This is the present focus for equipment updating.

Apart from being determined by boilers, energy utilization efficiency is also determined by technical equipment which uses steam and by other equipment which directly or indirectly consumes energy. The many types of heat exchangers used by enterprises in the chemical industry, for example, are energy-consuming devices. The choice of equipment which should be the target of necessary transformations at the present stage should be determined by the degree of technical maturity and by comparison of current average levels of energy conservation. That is to say, there should be a standard for comparison. As explained above, this standard is determined by a unit of investment in energy conservation and the average results of transformation of boilers which now have low efficiency.

If a planning and design department can gain a full understanding of the key points of energy conservation at different time periods and of the level of a unit of investment in energy conservation, then it can make suitable real judgements for transforming energy conservation in an enterprise. Planning departments can determine the direction of investments and choose projects for transformation of energy conservation by group and by time period based on the ability to make appropriations and on an understanding of standard investment and return levels in energy conservation.

## 2. The Principles for Investment in Energy Conservation Projects

The above discussion concerned the principles for taking China's current real conditions as the starting point for determining the depth of energy conservation and the principles of current standards for investment in energy conservation.

From the perspective of effective energy utilization, energy conservation is also a form of energy exploitation. For this reason, investments in the exploitation of energy resources will quite naturally become investments which reflect investments in energy conservation.

Investments for exploitation of energy resources and investments for exploitation of energy conservation have their similarities and differences.

First, they have qualitative differences. Energy resources are formed by nature. With hydropower as an exception, coal, petroleum and natural gas can be depleted after being exploited for a period of several years, even to the point of exhaustion. As a result of the increased depth of exploitation, there also will be yearly increases in investments for exploitation. Because energy conservation is determined primarily by technical levels, the potential for energy conservation exists throughout the entire process of exploitation, collection and transmission of energy resources, and all the way through the exchange of energy to its final utilization. There are efficiency questions at each link. Following the increased intensity of energy conservation work, efficiency will continue to increase and the potential for energy conservation will be reduced. For this reason, investments in energy conservation have increased rapidly. In 1980, for example, conserving a ton of standard coal only required an expenditure of 120 yuan. In some recent projects, however, this amount is about 150 yuan.



Second, energy conservation involves utilization of a portion of waste. This not only reduces waste of resources, but also reduces the amount to be transported and environmental pollution. At the same time, consideration should also be given to the relative concentration and long construction periods of investments in exploitation of energy resources. Investments in energy conservation have such special characteristics as being decentralized, greater ease in raising capital, shorter construction periods, and faster capital turnover.

The current control standard for investments for conservation of a ton of standard coal is the investment for extraction of a ton of standard coal at 350 yuan (including average storage and transportation costs). In research on the feasibility of an energy conservation project, however, there cannot be a single standard because of differences in concrete conditions. There should, of course, be a basic overall standard to serve as the starting point for deciding on the question.

When discussing the standards for investments in energy conservation, some people feel that the coal which is conserved can be exported. The export price of coal is higher than the domestic price of coal, so profits are high and investments in transformation for energy conservation can be greatly expanded. It is quite obvious that this viewpoint is superficial.

### 3. The Marginal Profit Rate of Investments in Energy Conservation

Investment standards for energy conservation projects are merely a necessary condition established for a project. The conditions are complete only if they satisfy economic results. That is to say, the feasibility of an energy conservation project should be determined through analysis of economic results. Distinguishing the unimportant from the important and the deferrable from the urgent based on the smallest permissible profit rate can be determined by the marginal profit rate of an investment. Projects with less than the marginal profit rate should not be carried out, or should at least be postponed temporarily.

First of all, we can still make comparisons from the perspectives of "opening up resources" and "reducing expenditures." The coal industry is a primary industry. The profit rate is low, however, and some coal mines still require subsidies from the state despite price readjustments. Therefore, the actual profit rate of the coal industry cannot be used as the marginal profit rate for energy conservation projects.

Secondly, in terms of the ability to repay loans, there are many sources of capital. There are state appropriations, money raised within the unit, bank loans and other forms. In order to expand the role of banks in the future and use the interest rate of bank loans as a lever, and to readjust the direction of economic development in macro-policy terms, current interest rates give preferential treatment to coal and energy conservation projects. The interest rate, is calculated at 0.21 percent per month. Repayment of the principal and interest begins from the day the contract is signed and cannot exceed

15 years in heavy industries or 10 years in general. During the period stipulated for repayment, the debtor can repay the principal and interest using the newly increased profits from the loan project after it goes into operation, the costs of fixed assets utilization and the depreciation fund which should be turned over to higher authorities. After receiving permission, high-tax low-profit projects can reduce or be exempted from payment of the unified industrial-commercial tax during the period specified for loan repayment.

For example, an energy conservation project receives a loan at preferential conditions and is completed within 4 years. At the end of the 5th year it begins to repay the debt and pays it off at the end of the 10th year. During the period of nonpayment of the industrial and commercial tax while the debt is being repaid, the lowest profit rate is 19 percent. Because of the long time period required for coal mine construction, if the same amount of capital is invested in coal mine construction with 15 years for repayment of the principal and interest and construction is completed in 7 years, the profit rate on the investment should not be less than 15 percent.

Below, I will look again at this question in terms of the normal returns to investments in energy conservation at present. It is assumed that the efficiency of a low-efficiency boiler will be increased from 50 percent to 65 percent after updating (this is the rate of efficiency which should be reached after the updating). The conditions for transformation are that a large part of the equipment can continue to be utilized, and the aim of the transformation is to update the primary equipment. In this way, the actual investment required for conserving 1 ton of standard coal per year is about 138 yuan. Calculated according to a selling price of 50 yuan per ton of standard coal, the reduced expenses for coal purchases in the enterprise can be taken as profits, and with the raising of capital in the form of loans, there will be a 34 percent rate of profit on the investment.

It can be seen that at present we still cannot spend large amounts of capital on energy conservation projects with low rates of profits on investments. We can only transform existing outdated equipment to about the same level and then spend large amounts of money to develop the depth of energy conservation.

It is inappropriate, of course, to set the marginal rate of profit for an energy conservation project too high. Excessively high rates do not favor development of energy conservation work. It is more appropriate to determine the lowest marginal profit rate based on the ability to repay the principal and interest of a bank loan. Based on the present rate of progress in project construction, current interest rates on loans and the stipulated period of 10 years for debt repayment, then it is best if the marginal profit rate is higher than 20 percent.

Some articles and decisions do not make use of the profit rate of investments, but instead use the period of principal repayment to measure economic results. Although this is relatively direct, it is not as easy to use as the profit rate on investments when comparing programs. There is, of course, no



contradiction between the two. If it is clearly specified that the period of principal repayment begins after a project goes into operation, then the repayment period is the reciprocal of the profit rate on investments. The current requirement of the state for energy conservation projects is that, in principle, the net investment for conserving about 1 ton of standard coal annually should not exceed 350 yuan, that the project should be completed in 3 to 4 years, and that the loan should be repaid within 5 years of project completion. Based on this requirement, the rate of profit on investments is about 20 percent.

#### 4. Methods of Comparing the Economic Results of Energy Conservation Projects

Which of two energy conservation projects with roughly equal results is best? In the past, this was usually decided by the method of "subsidy periods". The determination of a subsidy period, however, is a complex question. Moreover, there is no current stipulation of a subsidy period, and it is not easy to use. This author feels that using the "incremental evaluation method" is relatively accurate and feasible. This method means that investments may be divided into increments with obvious limits. Each of these increments has its own suitable profit rate. It not only demonstrates that an engineering project as a whole should and can be carried out, but also that each incremental profit rate can be used within a desired scope.

This method is a relatively direct means of distinguishing the feasibility of different degrees of energy conservation. For example, thermal efficiency is increased when outdated and backward boilers are transformed into high-efficiency boilers. The efficiency of small boilers, however, is far less than that of large boilers. If we wish to increase efficiency to more than 80 percent, then we must adopt large boilers to centralize heat supply or integrate the production of heat and electricity. The incremental evaluation method first involves making transformation of old boilers the foundation, followed by increased power generation and then taking the costs of increased power generation as the investment increment and seeing whether or not the benefits from the increment are above the marginal profit rate. The feasibility of the project can then be determined.

I will now do some economic analyses of whether or not the adoption of integrated heat and electricity production is necessary during boiler transformation in small enterprises which recover low-temperature waste heat and use about 10 tons of steam per hour.

The formula for the profit rate of investments is:

$$\begin{array}{l} \text{Profit rate on investments} \\ \text{(or profit recovery rate)} \end{array} = \frac{\text{Net profits} + \text{Fixed assets depreciation costs}}{\text{Total investments} \times K}$$

The K in the formula refers to the estimated investment coefficient which includes the interest rate. The normal figure is 1.15. When an engineering construction planning table is available, then it is calculated according to concrete conditions.

Net Profits = Income from Sales - Costs - Taxes.

Costs = (Fuel Costs + Fixed Assets Depreciation + Costs of Major Repairs + Wages) X a, where a is 1.10 to 1.12.

The Fixed Assets Depreciation Rate is 4 percent, and Cost of Major Repairs is assumed to be 1.8 percent of Fixed Assets.

Fuel costs are calculated at 50 yuan per ton of standard coal and electricity costs are figured at 0.08 yuan per KWH. Fixed assets depreciation is not calculated. The results of the calculations are shown in Table 1.

It can be seen from Table 1 that investments for power generation and energy conservation in Programs I and II exceed the investments for the exploitation of a ton of standard coal, and that only in Program II-B does the profit rate of investments exceed the profit rate from boiler transformation. Moreover, we are using back-pressure generators which require only small investments and have fairly good results in energy conservation. If bleeding generator sets are adopted, there will also be a decrease in benefits. This is especially true for Program I-B, where the loan cannot be repaid. In enterprises which use small amounts of steam, therefore, there should only be boiler transformation.

There are large numbers of small nitrogenous fertilizer plants in China. In order to turn losses into profits, some have increased the integrated production of heat and electricity, while others are preparing to do this. We feel that it is not practical to do this in small nitrogenous fertilizer plants with an output of less than 10,000 tons. The Tongxiang Chemical Fertilizer Plant (which produces 15,000 to 20,000 tons of ammonia annually) has done fairly well at integrating power generation. The investment to conserve coal there (418.5 yuan per ton of coal) exceeded the investment standard. Of course, there was a fuel shortage in Zhejiang Province so an appropriate increase in investments was permitted. This cannot be done in enterprises which use less than 10 tons of steam per hour or which have a generator steam exhaust pressure higher than 5 kg/square cm. This is especially true in existing boilers with efficiencies over 65 percent. Exchanging boilers simply for power generation is even less appropriate.

This problem also exists in the recovery of low-temperature waste heat. Recovery of low-temperature waste heat should first of all give consideration to serving as a source of heat and satisfying such heat supply needs as materials preheating, household heating, heating farm buildings, etc. Household and agricultural uses are subject to seasonal influences, however, and it is quite difficult to maintain equilibrium over four seasons. Thus, power generation with waste heat is rational, it is not possible with certainty given current economic results. In a program for power generation using low-temperature heated water from a steel foundry slag pool, for example, the investment for conserving a unit of coal is about 700 yuan, and the profit rate is about 10 percent. If the project was constructed with loans, it would be quite difficult to repay the principal and interest within the stipulated

period. Such a project could only be constructed if the establishment of power generation with waste heat brought additional benefits, or if the recovery of waste heat was essential for environmental reasons.

Table 2 is a comparison of programs for using low-temperature (160°C) waste heat for power generation in a petroleum refinery. A reduction in the cyclical utilization of techniques using cooled water means that the project should be constructed. The advantages of the investment increment method in the comparison of programs can be seen from these comparisons.

The investments for coal conservation in Programs I and III already exceed the standards, and the profit rate is also low. Now, using the incremental profit rate of investments to compare Program II with Program IV, the result is:

$$\begin{aligned} \text{Incremental profit rate on} &= \frac{\text{Net profit IV} - \text{Net profit II}}{\text{Total investments IV} - \text{Total investments II}} \\ \text{investments} &= \frac{37.65 - 28.61}{101.13 - 74.60} = 0.34 \end{aligned}$$

Although the incremental rate of profit on investments is lower than the overall profit rate in Programs II and IV, it is greater than the marginal profit rate, so Program IV is the best.

It can be seen from the results of the comparison that if there can be no reduction in the cycling of water in technical equipment during the process of power generation using low-temperature waste heat, then there will be no additional benefits, and none of the 4 programs should be constructed.

## 5. Conclusion

1) Investments in energy conservation are related to the stage and depth of energy conservation. There are different depths and different standards for a unit of investment in energy conservation at different stages. This standard should be based on the concrete conditions in China. It cannot be separated from the national conditions or involve a blind pursuit of progress.

2) A necessary condition for project construction is that a unit of investment in energy conservation must be less than a unit of investment in coal extraction, while satisfying the profit rate is a permissible condition for a project. Determination of the marginal profit rate of an investment in energy conservation should first of all be based on the actual ability to repay the principal and interest stipulated in the loan for energy conservation and secondly, there should be an appropriate increase based on the normal level at present in key energy conservation.

3) Comparison of project programs for energy conservation is made easier by using the investment increment method.

4) Enterprises which use less than 10 tons of steam per hour should not independently attempt to integrate heat and electricity production. They should take the road of regionally-integrated administration and centralized heat supply.

5) Recovery of low-temperature waste heat should first of all give consideration to serving as a source of heat. If there are no users of heat, then there temporarily can be no recovery if environmental conditions permit. If there are no additional economic benefits which occur at the same time as the recovery of low-temperature waste heat, then power generation at present is uneconomic.

Table 1. Comparison of Programs for Transformation of Small Industrial Boilers

Item	Program				
	I-A	I-B	II-A	II-B	III
Steam generator steam entry pressure (absolute pressure)	13	13	24	24	35
Steam generator steam entry temperature (degrees C)	340	340	390	390	435
Steam generator back pressure (absolute pressure)	3	6	3	6	10
Steam generator exhaust volume (tons/hour)	10	10	10	20	30
Efficiency of small boilers after transformation (percent)	65	65	65	65	65
Efficiency with adoption of power station boilers (percent)	65	65	65	77	88
Power generation capacity (kW)	410	200	550	958	7500
Coal consumption for power generation (tons/year)	510	255	638	1007	1380
Annual savings of coal with boiler replacement only (tons/year)	2649	2649	2649	5299	7948
Annual savings of coal with increased power generation (tons/year)*	545	259	730	1548	2480
Investments for boiler replacement only (1000 yuan)	365.6	365.6	365.6	731.3	1096.8
Investments for increased power generation (1000 yuan)	249	198	359	552	679
Costs of power generation (fen/kWh)	3.6	4.8	2.9	2.6	2.2
Annual profits from boiler replacement only (1000 yuan/year)	125.8	125.8	125.8	251.6	377.4
Annual profits from increased power generation (1000 yuan/year)	57.0	14.4	102.3	195.4	342.0
Unit of investment in energy conservation with boiler replacement only (yuan/ton of coal)	138	138	138	138	138
Unit of investment in energy conservation with increased power generation (yuan/ton of coal)	458	772	493	384	273
Profit rate on investments for boiler replacement only (percent)	34.2	34.2	34.2	34.2	34.2
Profit rate on investments for increased power generation (percent)	23.6	7.2	28.4	35.3	50

$$\text{*Savings of coal with power generation} = W \times \frac{3000}{7000} \times T \times 10^{-3} - \frac{W \times 860 \times 10^{-3}}{7000 \times n_b \times n_c}$$

W = Power generation capacity

T = Annual transmission time in hours

$n_b$  = Boiler efficiency

$n_c$  = Overall generator efficiency

Table 2. Comparison of Benefits From Power Generation With Low-Temperature Waste Heat

<u>Item</u>	<u>Program</u>			
	<u>I</u> Orthobutane Grade 1	<u>II</u> Steam Grade 1	<u>III</u> Orthobutane Grade 2	<u>IV</u> Steam Grade 2
Investments (1000 yuan)	1211.6	746.0	1526.6	1011.3
Power generation capacity (kW)	917.6	692.2	1066.8	897.2
Annual power generation (1000 kWh)	7341	5538	8534	7173
Annual income from power generation (1000 yuan/year)	513.9	387.7	597.4	502.5
Savings from equipment to cycle water (1000 yuan/year)	246.4	200.6	246.4	213.4
Income subtotal (1000 yuan/year)	765.0	588.8	846.4	715.9
Operations and depreciation (1000 yuan/year)	446.7	302.1	490.8	339.4
Net profit (1000 yuan/year)	318.2	286.1	352.9	376.5
Costs of power generation (yuan/kWh)	0.061	0.054	0.058	0.047
Total power generation costs (yuan/kWh)*	0.027	0.018	0.028	0.017
Amount of coal conserved (tons/year)	3141.9	2370.2	3652.9	3072.2
Investments for coal conservation (yuan/ton)	385.6	314.7	417.9	329.3
Profit rate on investments containing cycled water (percent)	26.26	39.35	23.11	37.22
Profit rate on investments not containing cycled water (percent)	5.54	11.46	6.97	16.12

\*Total power generation costs =  $\frac{(\text{expenses} - \text{costs saved from cycled water})}{\text{Amount of power generated}}$

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END



**END OF**

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**DATE FILMED**

23 July 1984